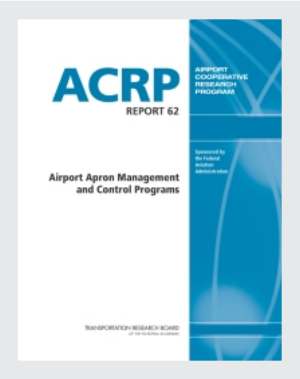

Airport Apron Management and Control Programs

DETAILS

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AIRPORT COOPERATIVE RESEARCH PROGRAM

ACRP REPORT 62

Airport Apron Management and Control Programs

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AIRPORT COOPERATIVE RESEARCH PROGRAM

Airports are vital national resources. They serve a key role in transportation of people and goods and in regional, national, and international commerce. They are where the nation's aviation system connects with other modes of transportation and where federal responsibility for managing and regulating air traffic operations intersects with the role of state and local governments that own and operate most airports. Research is necessary to solve common operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the airport industry. The Airport Cooperative Research Program (ACRP) serves as one of the principal means by which the airport industry can develop innovative near-term solutions to meet demands placed on it.

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The ACRP was authorized in December 2003 as part of the Vision 100-Century of Aviation Reauthorization Act. The primary participants in the ACRP are (1) an independent governing board, the ACRP Oversight Committee (AOC), appointed by the Secretary of the U.S. Department of Transportation with representation from airport operating agencies, other stakeholders, and relevant industry organizations such as the Airports Council International-North America (ACI-NA), the American Association of Airport Executives (AAAE), the National Association of State Aviation Officials (NASAO), Airlines for America (A4A), and the Airport Consultants Council (ACC) as vital links to the airport community; (2) the TRB as program manager and secretariat for the governing board; and (3) the FAA as program sponsor. In October 2005, the FAA executed a contract with the National Academies formally initiating the program.

The ACRP benefits from the cooperation and participation of airport professionals, air carriers, shippers, state and local government officials, equipment and service suppliers, other airport users, and research organizations. Each of these participants has different interests and responsibilities, and each is an integral part of this cooperative research effort.

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FOREWORD

By Michael R. Salamone
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ACRP Report 62: Airport Apron Management and Control Programs presents a compilation of apron safety statistics from U.S. and non-U.S. airports to draw conclusions as to the apparent effectiveness of apron management programs around the world. Through a common set of data and consistent definitions, the report is able to compare and contrast apron management programs around the world to U.S. airports, while considering the common operational and ownership differences between U.S. and non-U.S. airports.

The International Civil Aviation Organization (ICAO) universal safety audit of the United States recommended that FAA regulate operations on airport aprons by establishing an apron management service that meets the provisions of ICAO Annex 14, Paragraph 9.5.1. In simple terms, an "apron management service" would require ramp control and the establishment of practices and procedures that could improve safety by reducing the risk of aircraft and vehicle collisions and injury or death to persons on the apron.

However, in the United States, the airport operator does not typically control or manage air carrier apron operations. These operations usually occur on leased apron areas where the carrier or its ground handler has exclusive access and responsibility for operations. Because this area is leased, the responsibility for the safety of operations rests with the leaseholder.

Through ACRP Project 04-07, Ricondo & Associates conducted a comprehensive examination of apron management and control programs around the world to collect and analyze data on ramp accidents and evaluate the safety benefits of apron management and control programs in countries that regulate airport apron operations under ICAO Annex 14, Paragraph 9.5.1, with those programs and services at similar types of airports in the United States. The report effectively presents the differences among these programs and identifies their qualitative and quantitative benefits. The report describes how perceived benefits (namely, the awareness and prioritization of safety in the apron environment) are already apparent at U.S. airports given the high-priority airline and airport focus on safety in the airside areas.

CONTENTS

SECTION 1

Introduction

One of the most congested areas at any commercial service airport is the apron area adjacent to terminal facilities. Aircraft taxi to and from the gates while ground service equipment (GSE) used for aircraft servicing, catering, fueling, deicing, and baggage loading and unloading services operates in close proximity. Heightened awareness and focused coordination and communication are required to maintain safety among ramp workers, aircraft operations, ground vehicle operations, and in some cases, passengers.

At present, apron operations at airports in the United States are not typically controlled by the airport operator. Instead, airlines or other ground handlers direct operations in these busy areas. The result is that there are no consistent apron management and control standards across the U.S. aviation system. There is also no comprehensive system-wide database to track accident and incident statistics to quantitatively assess the safety of operations within these dynamic areas. Additionally, the data that are available are often described using terms and definitions that differ from airport to airport, making it extremely difficult to interpret system-wide trends.

Given the current situation regarding ramp safety in the United States, the essential objective of ACRP Project 04-07 was to evaluate the effectiveness and safety benefits of apron management and control programs in countries that regulate apron operations under the International Civil Aviation Organization (ICAO) Annex 14 and compare them with apron management and control programs in the United States, which are not currently regulated. In the context of this work effort, apron management and control programs are defined as regulations, policies, and systems designed to provide a safe and efficient environment in the ground area surrounding the terminal where aircraft, ground support, and servicing equipment and personnel operate simultaneously and in conjunction with each other. Issues that can be addressed by apron management practices include:

- Injuries to airline and airport personnel;
- Injuries to airline passengers and crew;
- Cost of damage to equipment, such as aircraft and GSE;
- Operational impacts due to accidents and incidents, ranging from operational delays to the costs of removing equipment from service for repair;
- Insurance considerations; and,
- Operational efficiency in and around the apron environment (i.e., improving aircraft turnaround time at the gate).

The consequences of an apron accident or incident can be substantial. They can be measured not only in terms of personal injury and equipment damage but also in operational impacts due to equipment being taken out of service. This makes apron management an issue of interest to various sectors of the industry, and significant benefits can be achieved if there is a reduction in incidents/accidents.

This study attempts to compile apron safety statistics using a common set of data and consistent definitions where possible. Reviewing this data as available in the context of qualitative information collected from U.S. and non-U.S. airports will facilitate an assessment of the apparent effectiveness of apron management programs. The research efforts will also project the applicability of apron management programs to U.S. airports, recognizing the common operational and ownership differences between U.S. and non-U.S. airports.

SECTION 2

Literature Review and Review of Accident/Incident Data Systems

A literature review and review of accident/incident data systems was performed to identify documents and data systems that would provide insight into apron management systems and data related to accident and incident occurrences in the airport terminal apron areas. The documents identified were useful in understanding the challenges of apron management and the diversity of data collection among aviation regulatory and industry organizations. Key documents and data systems reviewed are summarized in this section.

2.1 ICAO Annex 14—Section 9.5 on Apron Management Service

The ICAO standards and recommended practices for airports are specified in Annex 14, Volume I, *Aerodrome Design and Operations*. Section 9.5.1 provides the ICAO recommendation with regard to apron management services:

> 9.5.1 Recommendation—When warranted by the volume of traffic and operating conditions, an appropriate apron management service should be provided on an apron by an aerodrome ATS unit, by another aerodrome operating authority, or by a cooperative combination of these, in order to:
>
> a) Regulate movement with the objective of preventing collisions between aircraft, and between aircraft and obstacles;
> b) Regulate entry of aircraft into, and coordinate exit of aircraft from, the apron with the aerodrome control tower; and
> c) Ensure safe and expeditious movement of vehicles and appropriate regulation of other activities.

ICAO conducts "regular, mandatory, systematic, and harmonized safety audits" of its contracted (member) nations as part of its Universal Safety Oversight Audit Programme. The most recent ICAO audit of the United States took place in November 2007. Included in its findings was an ICAO recommendation that the United States establish federal requirements for an "apron management service" as described in ICAO Annex 14, Paragraph 9.5.1.

2.2 ICAO *Airport Services Manual,* Part 8, Airport Operational Services

Further details on apron management units are provided in ICAO's *Airport Services Manual,* Part 8, Airport Operational Services. Chapter 10 distinguishes between the aircraft movement area, control over which is the responsibility of the air traffic control service, and the apron, where it is recommended that an apron control unit regulate the movement of aircraft and vehicles. The need for highly coordinated communications between the apron control unit and the air traffic control service is emphasized.

This chapter also identifies typical responsibilities of apron management units as:

- Allocation of aircraft stands (gates) on the aprons,
- Maintenance of gate allocation documentation for landing and parking charges to the airlines,
- Providing marshallers for arriving aircraft to gates without docking guidance systems, and
- Apron services such as baggage and aircraft handling at some airports.

2.3 ICAO *Advanced Surface Movement Guidance and Control Systems (A-SMGCS) Manual*

ICAO's *Advanced Surface Movement Guidance and Control Systems (A-SMGCS) Manual* describes the system for aircraft and vehicle control in low-visibility operating conditions. In general this is an integrated system of surveillance, control and guidance, and communication with emphasis on the use of technology applications in these areas.

The manual specifies that A-SMGCS applies to apron areas where aircraft may come into conflict with vehicles or other aircraft and recommends that apron management units require designated areas for vehicles defined by painted lines

on the apron designating clear areas. The manual also identifies several areas in which apron management and control is integrated within the system. Apron management and control units should receive aircraft identification and position information, vehicle identification and position information, information on potential obstacles or hazards, and other information necessary in the apron area.

2.4 NTSB Definition of Aircraft Accidents and Incidents

Aircraft *accidents* and *incidents,* as used by the National Transportation Safety Board (NTSB), are defined in 49 CFR Part 830, Notification and Reporting of Aircraft Accidents or Incidents and Overdue Aircraft, and Preservation of Aircraft Wreckage, Mail, Cargo, and Records. The NTSB definition of an accident is "an occurrence associated with the operation of an aircraft . . . in which any person suffers death or serious injury, or in which the aircraft receives substantial damage." Serious injury is further defined as one of the following instances:

1. Requires hospitalization for more than 48 hours, commencing within 7 days of the date of the injury;
2. Results in a fracture of any bone (except simple fractures of fingers, toes, or nose);
3. Causes severe hemorrhages; nerve, muscle, or tendon damage;
4. Involves any internal organ; or
5. Involves second- or third-degree burns or any burns affecting more than 5% of the body surface.

NTSB defines an incident (as differentiated from an accident) as an "occurrence other than an accident, associated with the operation of an aircraft, which affects or could affect the safety of operations." Additionally, substantial damage is defined by the NTSB as "damage or failure which adversely affects the structural strength, performance, or flight characteristics of the aircraft. . . ."

Title 49 CFR 830 also sets the standard for reporting accidents and incidents to the NTSB. All accidents as defined previously must be reported. There are a category of incident cases that must also be reported. The key threshold related to reportable apron incidents is "damage to property, other than aircraft, estimated to exceed $25,000 for repair or fair market value in the event of a total loss."

2.5 GAO Report on Runway and Ramp Safety

In November 2007 the Government Accountability Office (GAO) released a report entitled *Aviation Runway and Ramp Safety: Sustained Efforts to Address Leadership, Technology, and Other Challenges Needed to Reduce Accidents and Incidents* (GAO-08-29). The GAO found that there is a lack of accident data related to ground handling operations, particularly for nonfatal accidents, hindering efforts to improve apron safety. Furthermore, since the federal government has had an indirect role in apron safety issues, there are no federal or industry-recognized standards on policies and procedures for apron operations.

2.6 ACI Survey on Apron Incidents and Accidents

Airports Council International (ACI) has historically surveyed member airports to gather information on the occurrences of apron incidents and accidents. The most recent report available was published in May 2009 and covers the years 2006 and 2007. Table 2-1 summarizes the number of airports responding to the ACI survey and the overall rate of accident/incident damage per 1,000 aircraft movements.

The data collected by ACI are self-reported by airport operators and reflect only that information the airport operator has

Table 2-1. Summary of ACI survey of apron incidents and accidents.

	2006		2007	
Region	Airports Responding	Damage Rate (Overall, per 1,000 Aircraft Movements)	Airports Responding	Damage Rate (Overall, per 1,000 Aircraft Movements)
Africa	12	0.259	12	0.182
Asia-Pacific	12	0.084	13	0.102
Europe	69	0.341	70	0.381
Latin America/Caribbean	53	0.125	53	0.107
North America	10	0.099	10	0.094
Total	156	0.230	158	0.245

Source: ACI Survey of Apron Incidents and Accidents 2006–2007, ACI World, May 2009
Prepared by Ricondo & Associates, Inc.

collected or that has been provided to the reporting airport by airlines and service providers. Due to a perceived reluctance by airlines and service providers to report all accidents and incidents and differences in reporting systems used across the world, the data collected are not considered to be complete or to accurately represent the true extent of these occurrences.

2.7 *ISAGO Standards Manual*

The International Air Transport Association (IATA) published the *ISAGO Standards Manual* in May 2008. ISAGO (IATA Safety Audit for Ground Operations) is a centralized audit system based on internationally recognized practices. The *ISAGO Standards Manual* provides standards and recommended practices to improve operational safety in the airport ground operations environment and to reduce damage to aircraft and equipment. It prepares airlines and other ground service providers for the ISAGO.

2.8 ICAO Common Taxonomy Team

As part of the development of an international standard for reporting aircraft-related accidents and incidents, ICAO chartered the Common Taxonomy Team in conjunction with the Commercial Aviation Safety Team. Since 2002, the Common Taxonomy Team has developed sets of naming conventions and definitions covering broad categories such as *phase of flight, occurrence, aircraft make/model,* and *engine make/model.* The most applicable definitions for apron-area accidents and incidents are within the *occurrence* category and were published in October 2008—specifically, *ground handling* and *ground collision.* Ground handling includes "occurrences during or as a result of ground handling operations," such as collisions with servicing or boarding equipment, collisions during pushback or power back, and injuries from propeller or fan blade strikes. Ground collision includes aircraft collisions while taxing to or from the runway (but not on the runway), including taxiing on the apron. This category definition notes that accidents/incidents categorized under ground handling are excluded from the ground collision category.

2.9 Occupational Safety and Health Administration Data

The purpose of the Occupational Safety and Health Administration (OSHA) is to reduce workplace fatalities, injuries, and illnesses by promoting workplace safety and health. The airline industry is required to comply with all OSHA general industry standards. Recognizing the issue of personnel safety in the apron environment, OSHA and the National Air Transportation Association's (NATA) Airline Services Council established an alliance to provide NATA members and others with information, guidance, and access to training resources to protect employees' health and safety.

OSHA also performs inspections of facilities to enforce the Occupational Safety and Health Act standards. Inspections may be planned, referral based, complaint driven, as a response to an accident, or as a follow-up to a previous inspection. Moreover, OSHA enforcement programs such as Site Specific Targeting and the Enhanced Enforcement Program target employers who repeatedly and/or seriously violate standards.

OHSA maintains the Integrated Management Information System (IMIS), which contains records of OSHA investigations. According to the OSHA website, the IMIS was designed for internal use by OSHA and state agencies that carry out federally approved OSHA programs. IMIS information is entered into the database as events occur and is subject to change until cases are closed. The database contains 1,825 inspections for the transportation-by-air industry from 2004 through 2008. Unfortunately, the inspection reports do not include whether the inspection or violations cited during the inspection were in the apron area.

However, the database does include accident investigation reports. These contain descriptions of the accidents, from which it can be determined whether the accident occurred in the apron area. It should be noted that this data set also has limitations in its applicability to the research project. Some accidents investigated by OSHA may not be included in the database, particularly where state health and safety agencies share investigation reporting with OSHA. Additionally, the database does not include data after July 2006. For this review, a 3-year period from July 2003 through July 2006 was used. The accident investigation reports include Standard Industrial Classification (SIC) codes, and the database contained 52 accident reports identified by the major SIC category "Transportation by Air" for the time period examined. Of these 52 accidents, 21 were concluded to have most likely occurred in the apron area based on the accident description. Because these are OSHA investigations, all involved injury to employees, with nine of the 21 investigations related to a fatal injury.

Of the 21 apron area accident investigations by OSHA, 13 were related to vehicle or equipment collisions with personnel. Six concerned people falling from equipment or stairs. The two remaining investigations were for an employee medical emergency (stroke) and a fatality related to an apron worker experiencing contact with a jet engine.

2.10 FAA Daily Regional Alert Bulletin

An FAA Daily Regional Alert Bulletin query for tow-vehicle–related occurrences was provided by FAA representatives on the ACRP 04-07 Project Panel. This dataset covered the period from October 1, 2007, through September 30, 2008.

Using the air carrier records of occurrences in the apron area, these data reported 23 ground-collision types of accidents, primarily in the form of towed aircraft collision with parked aircraft, ground equipment, vehicles, and in one instance, with a ramp worker, resulting in an injury.

2.11 NASA Aviation Safety Reporting System

NASA's Aviation Safety Reporting System is a voluntary reporting system of aviation incidents that protects the identity of individuals making the report. The reports are not corroborated with other agency investigations, and in most cases the airport at which the incident occurred is not identified in the report narratives. A query of this database was made covering the period of 2000 through November 2009. Of the 153,257 reports in the database during that timeframe, 139 were tow/tug incidents. Of those incidents, 31 were runway or taxiway incursions by tug vehicles with or without an aircraft in tow. The remaining 108 reports covered all other types of tow/tug incidents. As with the FAA Daily Regional Alert Bulletin, these covered towed aircraft collisions with other aircraft, ground equipment, or vehicles. Other cases included issues during pushback such as tow-bar failure or nose-gear damage resulting from operator error during the pushback.

As these data are voluntarily reported and the airport is not discernible, the data are of limited use for statistical analysis related to this project.

2.12 Other Accident and Incident Databases

Other accident and incident databases were identified during the review for which access to the data sources was not available. In the United States, the Air Transport Association and the Regional Airline Association each collect data from their member airlines. Citing the sensitivity of releasing accident and incident data reported by the airlines, access to the data by the research team was not made available by either organization.

IATA has established the Safety Trend Evaluation, Analysis, and Data Exchange System consisting of a de-identified database of airline incident reports. According to IATA's website, these data can be analyzed for comparison and benchmarking purposes. Participation by the IATA member airlines is voluntary, and access to the data is limited to those airlines participating in the program.

2.13 Factors Relevant to Apron Management and Control

Through the literature and database review, factors were identified that are relevant to the application of an apron management and control program. These factors influence the applicability of such programs at U.S. and non-U.S. airports:

- Regulatory environment
  - Civil aviation authorities
  - Occupational safety agencies
  - Air traffic service provider
- Operational environment
  - Dominant hub versus non-hub
  - Aircraft operations levels and peaking characteristics
  - Responsibilities of apron control units or ramp towers
  - Start-up clearances
  - Movement area/non-movement area coordination
  - Personnel training
  - Notification of work-in-progress and non-available facilities
- Current business practices
  - Allocation or leasing of gates—common use or exclusive/preferential use
  - Ground handlers/service providers
  - Insurance and liability considerations
  - Apron safety training for employees
  - Driver's licensing and recurrent training
- Accident/incident reporting
  - Reporting required by civil aviation authorities
  - Reporting required by airports
  - Internal reporting by airlines and service providers
  - Threshold for reporting accidents/incidents
  - Accessibility of accident/incident data or reports

SECTION 3

Apron Management Characteristics Survey for U.S. Airports

A survey effort was undertaken in an effort to determine the extent of apron management and control programs in use at contacted airports in the United States as well as to understand the operational characteristics and contextual operating environment of each. In an effort to maximize the survey response rate and minimize the potential perception of recipients that the survey was too large or time-consuming to complete, the survey instrument was designed for online completion at the respondent's convenience. This first step in the process was viewed as a screening effort, whereby the research team could target those responding airports that were judged to have the most relevant and useful information to the research effort and that were willing to participate.

3.1 Survey Administration

The online screening survey effort was designed to assist in the collection of data used to select the six medium and large hub airports for which a more detailed data collection effort would be conducted in the form of on-site interviews and data collection. The research team distributed the online survey to the 66 medium and large hub airports (as defined by the FAA) in the United States. Large hubs have a total enplanement level of 1% or more of the total U.S. enplanements in the fiscal year; medium hubs have between 0.25% and 0.99% of total U.S. enplanements. The online survey is a practical tool used to extend the research team's outreach to ensure the opportunity for participation from as many airports as possible.

The primary objectives of the online survey were to identify operational characteristics of the apron environment and request information related to apron management regulations, policies, and procedures. A transmittal email sent in concert with the link to the online survey website described ACRP Project 04-07, the intent of the online survey, and contact information for the research team. The survey itself was designed for online completion by the respondents. Respondents were able to complete the survey as their schedules allowed since the survey mechanism provided intermittent opportunities for respondents to save their place in the survey process. A copy of the online screening survey is included in Appendix A.

Following a review of the initial survey responses, the research team sent out email reminders to those airports that had not yet responded and followed up with phone calls in further attempts to increase the response rate.

3.2 Response Rate

The survey invitation was emailed to the 66 medium and large hub airports. By the completion of the survey effort, which encompassed 14 weeks including the email reminders and follow-up phone calls, a total of 18 airports participated in the survey, representing a response rate of 27%. By comparison, 10 airports in North America responded to the ACI Survey on Apron Incidents and Accidents in 2006 and 2007 (summarized in Section 2.4). Table 3-1 lists the airports responding to the survey. The results received provide insight into the attributes of apron management and control that are in use in the United States and the regulations related to apron management. Most importantly, the survey provided useful data in screening to identify the six U.S. airports for further investigation.

3.3 Survey Results

This section summarizes the results of the online screening survey. It is important to note that this section only includes results in an aggregate format consistent with that commitment in the survey invitation.

The first question ("Who manages the apron area at your airport?") was designed for understanding the perception of the responsibility for the management of the apron area. The majority of respondents indicated that airlines manage the apron area associated with their respective gates (72%).

Table 3-1. Airports responding to the apron management survey.

Airport	Hub Classification
Chicago O'Hare International Airport	Large
Baltimore/Washington International Thurgood Marshall Airport	Large
Port Columbus International Airport	Medium
Ronald Reagan Washington National Airport	Large
Denver International Airport	Large
Dallas/Fort Worth International Airport	Large
Fort Lauderdale International Airport	Large
Los Angeles International Airport	Large
Memphis International Airport	Medium
Milwaukee General Mitchell International Airport	Medium
Minneapolis–St. Paul International Airport	Large
Oakland International Airport	Medium
Omaha Eppley Airfield	Medium
Palm Beach International Airport	Medium
Phoenix International Airport	Large
San Diego International Airport	Large
Salt Lake City International Airport	Large
Lambert–St. Louis International Airport	Medium

Source: ACRP Project 04-07 Online Airport Apron Management Screening Survey
Prepared by Ricondo & Associates, Inc.

The remaining 28% of respondents indicated that the airport managed the apron area.

When asked if a set of regulations or procedures that covered apron operations was in place, only 50% of airports responded affirmatively, as summarized in Table 3-2. When asked about the development of those procedures, 33% reported that apron operating procedures were developed by the airport and 17% by the airport with some level of coordination with the airlines. One of those airports noted that those procedures were developed and updated as part of the airport's Federal Air Regulations (FAR) 14 CFR Part 139 Airport Certification Manual. Thirty-three percent cited the airlines as the sole responsible agency for development of apron management regulations or procedures.

All of those respondents that did not have apron-specific regulations or procedures in place indicated in a follow-up question that the airlines were responsible for development of apron regulations or procedures.

Compliance with apron regulations was reported to be monitored or audited by airport operations personnel, airport police, or a combination. All airports with regulations in place reported daily or continuous frequency in auditing compliance with apron regulations.

Of interest was the number of airports with ramp towers in operation for either all or a portion of the apron area. Sixty-three percent of responding airports reported ramp towers in operation (Table 3-3). Of those, one-half reported ramp tower control over all apron areas; the other half were limited to portions of apron areas based on airline gate/location assignments.

Further breaking down the airports with ramp tower control, 54% reported movement control of aircraft only

Table 3-2. Apron regulations or procedures.

Apron Regulations or Procedures in Place	Percent
Yes	50
Developed by airport	33
Developed by airport and airlines	17
No	50

Source: ACRP Project 04-07 Online Airport Apron Management Screening Survey
Prepared by Ricondo & Associates, Inc.

Table 3-3. Apron control in place.

Apron Control	Percent
Ramp tower	63.0
All apron areas	31.5
Portions of apron areas based on airline assignment	31.5
Uncontrolled	37.0

Source: ACRP Project 04-07 Online Airport Apron Management Screening Survey
Prepared by Ricondo & Associates, Inc.

Table 3-4. Ramp tower control.

Movements Controlled by Ramp Tower	Percent
Aircraft only	54
Aircraft and vehicles	38
Other – aircraft and tugs on pushback	8

Source: ACRP Project 04-07 Online Airport Apron Management Screening Survey Prepared by Ricondo & Associates, Inc.

(Table 3-4). Thirty-eight percent reported ramp tower control over aircraft and vehicles. One other response was received indicating that aircraft and tugs on pushback were movements controlled by the ramp tower.

In regard to the types of operators permitted on the apron, it was not surprising that each respondent indicated numerous operators. As shown in Table 3-5, categories such as security, aircraft cleaning, fueling, baggage handling, and catering/flight kitchen are permitted by each airport. Deicing operators were reported as allowed on the apron by 73% of the responding airports, a result that is likely due to airports in warm-weather climates and airports without deicing pads that are remote from the terminal. Likewise, snow removal was only reported by 67% of airports, all in colder climates. One "other" category response was noted to include special vehicles under escort. The number of functions in the apron area and the separation of these functions by airport, airline, and third-party contractor are important to understand in the context of operating under an apron management and control program and how each airport regulates multiple groups of employees working on the apron.

To expand on the wide range of operators that can operate on the apron, Table 3-6 presents the responses related to the requirements that airports have for operators on the apron. Training and certification were required at 72% and 39% of airports, respectively. Other requirements included insurance, sponsorship by an air carrier, security badging, and permits or leases. A follow-up question revealed that 73% of respondents had a mandatory driver-training program in place for apron employees (Table 3-7).

Table 3-5. Types of operators permitted on the apron.

Operator Category	Percent Responding
Aircraft cleaning	100
Aircraft deicing	73
Aircraft fueling	100
Aircraft servicing	93
Airline personnel	100
Baggage handling	100
Catering/flight kitchen	100
Concession deliveries	87
Contract maintenance	93
Fixed-base operator (FBO)	67
Security	100
Snow removal	67
Other (special vehicles under escort)	7

Source: ACRP Project 04-07 Online Airport Apron Management Screening Survey Prepared by Ricondo & Associates, Inc.

Table 3-6. Requirements for third-party operators.

Requirement	Percent
Training	72
Certification	39
Other	28
Insurance requirements	11
Air carrier sponsor	6
Security badging requirement	6
Permit or lease requirement	6

Source: ACRP Project 04-07 Online Airport Apron Management Screening Survey Prepared by Ricondo & Associates, Inc.

The next series of questions in the survey relates to the establishment of an apron safety oversight organization, described in the survey as an apron safety committee or comparable entity. As presented in Table 3-8, only 61% of responding airports have such a committee or group in place. An open-ended follow-up question was asked regarding the scope of the committee. The responses were similar in that the committee was generally made up of airport and airline personnel and met, either regularly or on an as-needed basis, to discuss safety issues that had arisen.

A safety management system (SMS) is defined by the FAA as the "formal, top-down business approach to managing safety risk, which includes a systemic approach to managing safety, including the necessary organizational structures, accountabilities, policies and procedures" (Order VS 8000.367, Aviation Safety (AVS) Safety Management System Requirements, May 14, 2008). SMSs have been in use at airports outside the United States (see Sections 4.1.2 and 4.2.2) and are being more widely implemented at airports in the United States. Although not specifically identified, apron management and regulation is clearly within the context of the four components of an SMS: safety policy, safety risk

Table 3-7. Driver training for apron employees.

Mandatory Driver Training	Percent
Yes	73
No	27

Source: ACRP Project 04-07 Online Airport Apron Management Screening Survey Prepared by Ricondo & Associates, Inc.

Table 3-8. Apron safety committee or comparable entity.

Apron Safety Committee or Comparable Group in Place	Percent
Yes	61
No	39

Source: ACRP Project 04-07 Online Airport Apron Management Screening Survey Prepared by Ricondo & Associates, Inc.

Table 3-9. Safety management system in place.

Safety Management System in Place	Percent
Yes	6
Includes apron area	6
No	94

Source: ACRP Project 04-07 Online Airport Apron Management Screening Survey Prepared by Ricondo & Associates, Inc.

management, safety assurance, and safety promotion. Therefore, the project panel recommended that questions regarding SMSs be included in the screening survey to determine if responding airports have implemented an SMS and how apron control programs can be integrated into an SMS. Only one responding airport reported an SMS in use (Table 3-9). Follow-up questions indicated that the apron area was included in the SMS process. The SMS approach includes monitoring for adherence to safety procedures, collectively referred to as audits. The one airport with an SMS indicated that no audit process was in place.

The next series of questions in the screening survey is related to the reporting of apron accidents and incidents; specifically, reporting procedures (Table 3-10) and the threshold for which an event would be reported as an accident or incident. In terms of a standard procedure for reporting accidents and incidents to the airport at which they occurred,

Table 3-10. Accident and incident reporting procedures.

Standard Procedure for Accident/Incident Reporting	Percent
Yes	55
Incident reports submitted by tenants to the airport	11
Reported by phone to operations center or police dispatch	44
No	45

Source: ACRP Project 04-07 Online Airport Apron Management Screening Survey Prepared by Ricondo & Associates, Inc.

45% of respondents indicated that no standard was in place. Of the 55% with a standard reporting procedure, the majority reported that telephone notification to airport operations or police dispatch was the reporting mechanism. The remainder relied on reports submitted by tenants. Open-ended questions were asked of those airports with a standard procedure in place addressing what is considered an accident versus an incident. The responses varied widely. On one end of the response spectrum, a respondent indicated that there was no classification of incident or accident. Several reported that minor damage to property (other than aircraft) was considered to be a reportable incident, while major damage or injury was reportable as an accident. One airport respondent cited ACI's definition of aircraft incidents and accidents, which mirrors the NTSB definition as the reporting standard.

Finally, the screening survey asked for the identification of initiatives or programs that airports have instituted to improve apron safety. Common themes among respondents included foreign object damage (FOD) prevention programs and general safety awareness programs or events for apron workers. A winter operations safety awareness program was also noted by multiple airports. Noteworthy programs that stand out include a program of movement-area training for ground handlers, ramp personnel, and aircraft maintenance personnel, and recurring driver training for apron personnel.

SECTION 4

Apron Control Characteristics for Airports Outside the United States

Data were collected on the systems, rules, regulations, procedures, and practices that are used at non-U.S. airports that have implemented the apron management and control requirements addressed in ICAO Annex 14. These data provide context for understanding a range of options for implementing an apron management program and may, if appropriate quantitative data are collected, allow the assessment of the effectiveness of various systems, practices, and procedures.

The approach to identifying apron control characteristics outside the United States differed from the online screening survey used for U.S. airports because the definition and implementation of apron management and control differs across the world. Data collection was accomplished through direct contact (interviews) with civil aviation authorities and personnel at airports. Civil aviation authorities were contacted to determine the extent to which ICAO Annex 14 apron control requirements were mandated for airports within that country. Representative airports were contacted in order to determine how their respective apron areas were managed and controlled and to request copies of applicable policies, procedures, rules, and regulations. In addition, the European Aviation Safety Agency (EASA) and the European Agency for Safety and Health at Work were also contacted in order to determine the applicability of European Union (EU) safety management and occupational health and safety regulations in airport apron management and control.

A total of 19 regulatory authorities were contacted as part of this effort. These regulatory authorities, which included but were not limited to civil aviation authorities, ministries, and departments of transportation, were contacted in order to determine whether regulations concerning apron management and control had been enacted within their country.

For each of the 19 countries contacted, at least one representative airport was contacted in order to determine how their respective apron areas were managed and controlled and to request copies of applicable policies, procedures, rules, and regulations. A total of 23 commercial service airports were contacted. Information obtained included:

- Identification of parties responsible for the control of aircraft, vehicles, and equipment operating on the apron areas and the scope of their responsibilities;
- Apron management and control limits (boundaries);
- Use of airport data management systems and other software systems;
- Airside-specific operational policies, procedures, rules, and regulations;
- Certification of ground handling operators, including catering and fueling companies; and
- Role of an airport SMS.

4.1 Findings from Civil Aviation Authorities

As noted previously, civil aviation regulatory agencies were contacted to document regulations concerning apron management and control within their respective countries. Table 4-1 presents the countries contacted and indicates which have established national regulations regarding apron management and control.

4.1.1 Apron Management Regulation at the National Level

It was determined that the only countries contacted that had specific regulations for apron management and control were China, Japan, and the United Arab Emirates (UAE). In the cases of Japan and UAE, the civil regulations are taken directly from ICAO Annex 14, Section 9.5, requiring an apron control unit. China's regulations are more robust and cover the following six areas of apron operations:

1. Apron check and aircraft parking position management,
2. Aircraft operations management on the apron,

Table 4-1. Establishment of apron management and control regulations by country surveyed.

Country	Apron Management and Control Regulations
Canada	No
China	Yes
Denmark	No
Finland	No
Germany	No
Greece	No
Ireland	No
Italy	No
Japan	Yes
Luxembourg	No
Netherlands	No
Norway	No
Portugal	No
South Korea	No
Spain	No
Sweden	No
Switzerland	No
United Arab Emirates	Yes
United Kingdom	No

Source: Ricondo & Associates, Inc.; Planport GmbH
Prepared by Ricondo & Associates, Inc.

3. Apron vehicle and facilities management,
4. Personnel management,
5. Environmental and hygiene management, and
6. Fire protection management.

For the remaining countries, the issue of managing and controlling aircraft, vehicles, and ground support equipment on the airport apron areas was determined to be the responsibility of the respective airport and the local air traffic service provider. It was found that regulatory authorities generally viewed apron management functions as part of the development and implementation of airport SMSs in accordance with ICAO requirements.

4.1.2 Safety Management System Regulations

All countries contacted had enacted regulations concerning the development and implementation of an SMS, and these regulations were in accordance with the ICAO safety management requirements, with the exception of South Korea, which did not respond to questions regarding an SMS. The ICAO safety management requirements include the development and implementation of state safety programs (SSPs), which improve and enhance all aspects of aviation safety within the country, and the development and implementation of an SMS by all aviation service providers, which include training organizations, aircraft operators, approved maintenance organizations, aircraft manufacturers, air traffic service providers, and aerodrome operators.

It is important to note that the ICAO safety management requirements do not specifically require ground handling operators such as catering and fueling companies to develop and implement such systems. As such, the inclusion of ground handling operators into the SMS process has been handled differently both by countries and their respective airports. For example, Denmark and Greece require ground handling operators, including catering and fueling companies, to develop and implement an SMS that is not only compatible with the operating airport's SMS but integrated into it; Germany, the Netherlands, Portugal, and Switzerland do not require ground handlers to develop and implement an SMS. The Netherlands does, however, encourage ground handlers operating at Dutch airports, including Schiphol International Airport, to develop and implement the ISAGO safety program.

In addition to the SMS regulations, some countries, such as the United Kingdom, have developed guidance material to assist airports with the development and implementation of airside-specific safety management plans. This guidance material, known as Civil Aviation Publication (CAP) 642, *Airside Safety Management,* outlines the principles behind airside health and safety management and identifies ways of mitigating various airside risks by recommending best management practices for airside-related activities such as moving aircraft (pushback, power back, or towing) and the operation of support equipment (loading bridges, visual display docking systems, 400-Hz power, and preconditioned air units). It also identifies and describes safety measures to be taken into consideration in the operation and driving of airside vehicles. Safety training and safety performance management and measurement are also identified and described in the guidance document.

With respect to EU directives regarding safety management, there are currently no specific directives requiring member states or service providers to develop and implement an SSP and an SMS. As such, the EASA is currently in the process of reviewing how member states interpret and implement ICAO-related requirements, including safety management requirements. The intent of this review is to identify the strengths and weaknesses of the ICAO requirements and to determine the most appropriate means of implementation. This information will then be used as a basis for developing specific European directives pertaining to the development and implementation of member state SSPs and service provider SMSs. It is the intent of EASA to include and address

ground handling service providers, including catering and fueling companies, in the legislative process. EASA's goal is to harmonize safety management standards while creating uniform audit processes for all member states and service providers, including ground handling operators. A draft directive pertaining to SMS and apron management and control is expected to be released by the end of 2013.

4.1.3 Other Regulations Related to Apron Management

Regulatory authorities in China, Greece, Ireland, Portugal, Sweden, Finland, Japan, and UAE also indicated that they had enacted regulations pertaining to the certification of ground handling operators for operation at airports within their respective countries, while the United Kingdom indicated that it had not. Denmark is currently in the process of developing such regulations.

For EU member states, these regulations are related to the European Council (EC) Directive 96/67/EC concerning the liberalization of the ground handling market within the EU and seek to ensure that all ground handlers wishing to operate at airports within the member states are financially sound, carry proper insurance coverage, and have proper safety and security procedures in place covering installations, aircraft, equipment, and personnel. They also seek to ensure compliance with local, national, and EU-related environmental protection laws and all relevant social legislation.

The implementation of the ground handling regulations by the EU member states is either the responsibility of the issuing civil aviation regulatory authority or an independent authority such as a commercial commission within the country. Portugal, Sweden, and Finland have elected to implement these regulations through issuing authorities, while Ireland has elected to implement them through an independent authority, the Commission for Aviation Regulation. Some member states, such as Greece and Denmark, have also decided to delegate the implementation of the regulation to the respective airports, while others, such as the United Kingdom, consider it to be the airport's responsibility to comply with the EC directive. As such, Athens, Copenhagen, Heathrow, and Gatwick International Airports have developed and implemented their own certification process, which is based on policies, procedures, rules, and regulations designed to comply with either national regulations or the EC directive. In the case of Athens and Heathrow International Airports, these airports have created ground handling divisions responsible for managing the certification process and daily ground handling operations.

The General Civil Aviation Authority (GCAA) of the UAE has recently implemented the Reporting of Safety Incident (ROSI) system for aircraft accident and incident reporting. Currently, the system is only available to the UAE airlines (Etihad Airways and Emirates Airlines) and is not mandatory. Airport operators and third-party operators have not been invited to participate as of this writing. Airlines can complete the ROSI form online, and the entered data are reviewed by the GCAA. Access to the online system is limited to GCAA program staff and the airline safety officers. In the first 4 months of operations, the GCAA had only received 48 notices of incidents. Previously, the incidents reported included only those noticed by air traffic controllers. When an incident occurs, air traffic controllers manually complete a form that is faxed to the GCAA offices. This process continues to be in use in addition to the ROSI system.

The GCAA has assigned three people to review and investigate incidents reported by the airlines through the ROSI system, as well as a single supervisor who reviews staff-proposed actions or comments. The database is reviewed on a daily basis for new postings, and all actions that follow are documented in the system/database. Before ultimately making the reporting accessible to airport operators and third-party operators in the future, the GCAA is in the process of ensuring that the system is working properly and that the GCAA has the proper resources to follow up on the incidents being reported. The GCAA envisions use of the database to identify trends and areas on which to improve.

Airlines can report incidents that take place outside the UAE to the ROSI system. Since the GCAA does not have jurisdiction over airports and airspaces beyond the UAE, in response to a report in the ROSI system, the GCAA can only send a letter to the proper regulatory agency to inform them of the incident.

4.2 Findings from Airports

As part of the data collection process, 23 commercial service airports were contacted to inquire as to how they managed and controlled aircraft, equipment, and vehicles operating on their respective apron areas. This section presents the initial findings related to airport apron control programs. With respect to aircraft control, it was determined that aircraft operating on the passenger terminal and air cargo apron areas are either the responsibility of a dedicated airport apron control unit or of the local air traffic service provider, recognizing that the ultimate responsibility for aircraft control rests with the pilot in command of the aircraft. Of the 23 airports contacted, 10 have an established airport apron control unit that actively controls aircraft operating on the terminal apron. Table 4-2 presents all airports contacted as part of this research and identifies the 10 airports with apron control units.

Table 4-2. Apron control units at airports outside the United States.

Country	Airport	Airport Identifier	Annual Operations* (2008)	Apron Control Unit
Canada	Toronto Pearson International Airport	YYZ	430,588	Yes
China	Beijing Capital International Airport	PEK	431,670	Yes
	Chengdu Shuangliu International Airport	CTU	158,615	Yes
Denmark	Copenhagen Airport	CPH	264,095	No
Finland	Helsinki Airport	HEL	184,836	No
Germany	Frankfurt am Main Airport	FRA	485,783	Yes
	Munich International Airport	MUC	432,296	Yes
Greece	Athens International Airport	ATH	199,418	No
Ireland	Dublin Airport	DUB	211,804	No
Italy	Bologna Marconi Airport	BLQ	62,042	No
Japan	Narita International Airport	NRT	193,321	Yes
Luxembourg	Luxembourg Findel Airport	LUX	83,141	No
Netherlands	Schiphol International Airport	AMS	446,592	No
Norway	Oslo Airport	OSL	211,048	No
Portugal	Lisbon Portela Airport	LIS	144,800	No
South Korea	Incheon International Airport	ICN	211,404	Yes
Spain	Madrid Barajas Airport	MAD	469,740	No
Sweden	Stockholm Arlanda Airport	ARN	218,549	No
Switzerland	Zurich Airport	ZUR	268,476	Yes
United Arab Emirates	Abu Dhabi International Airport	AUH	93,163	Yes
	Dubai International Airport	DXB	260,530	Yes
United Kingdom	Gatwick International Airport	LGW	266,552	No
	Heathrow International Airport	LHR	478,518	No

Source: Ricondo & Associates, Inc.; Planport GmbH
Prepared by Ricondo & Associates, Inc.
*Number of takeoffs and landings

4.2.1 Apron Control Units

This active control is achieved through the issuance of aircraft taxiing guidance (as opposed to instructions) since the apron controllers at these airports are generally not certified air traffic controllers. They do, however, hold federally issued radio operators' licenses and are required to undergo comparable similar levels of training, including airport familiarization training.

The apron control units at all airports were established in order to manage ramp and gate facilities (common use, in most cases) and provide operational efficiencies by optimizing and maximizing the use of passenger terminal and air cargo terminal facilities and associated apron areas. The majority of airports with apron control units reported a level of coordination with the air traffic service provider and cited delegation of responsibilities through memorandums of understanding or comparable agreements. In the case of FRA and MUC (see Table 4-2 for airport code identities), regional legislation dictates the division of responsibilities between air traffic control and apron control.

The apron control units are generally located within either the respective airport's airside or operations departments or divisions. The units provide active aircraft control 24 hours a day, 7 days a week.

ZUR, YYZ, Charleston International Airport (CHT), and AUH each have one apron control tower, while Frankfort Capital City Airport (FFT), MUC, PEK, NRT, DXB, and ICN have two. A third apron control tower is currently under construction at FFT and will commence operations upon opening of the new south passenger terminal.

There are approximately 26 apron controllers employed at ZUR, while FRA and MUC employ approximately 80 and 60 apron controllers respectively. At YYZ, the apron management unit consists of 28 apron controllers, while NRT's apron control staff consists of 36 controllers.

With respect to the apron controller's area of responsibility, the controllers at both FRA and ZUR control aircraft operating on both the airport taxiways and apron areas. All other airports' apron controllers only control aircraft operating on the apron areas, with control of aircraft on taxiways and runways being the responsibility of the air traffic service provider.

The apron control units have dedicated and published apron control frequencies that are integrated with the air traffic service provider's frequencies. This integrated communication system allows for the seamless and sequential delivery of guidance information, instructions, and clearances to aircraft arriving at and departing from the respective airports. Aircraft arriving at airports will receive approach and landing clearance from the air traffic service provider, while taxiing instructions and guidance information are provided in accordance with the area of responsibility noted previously. Departing aircraft receive clearance information from the respective air traffic service provider, while engine start and pushback clearances are provided by the apron control units. As with aircraft arriving at the airport, taxiway instruction or guidance information is provided by either the apron control unit or air traffic service provider, while departure and en-route clearances are provided by the respective air traffic service provider.

The control of aircraft on the passenger terminal and air cargo aprons at CPH, LGW, LHR, LIS, and AMS is the responsibility of the local air traffic service provider. At CPH, a separate apron control unit has been established by the air traffic service provider to manage and control aircraft operating on the passenger terminal and air cargo aprons, while at LGW, LHR, LIS, and AMS apron control is provided by the air traffic service providers' ground control divisions. Control of aircraft operating on the passenger terminal and air cargo aprons at ATH, DUB, and ARN is the responsibility of the pilot in command, and as such, they operate on a see-and-be-seen basis.

As for the control of equipment and vehicles operating on the passenger terminal and air cargo aprons, airports generally indicated that they do not provide active control. As such, it is the responsibility of the equipment and/or vehicle operator to control and operate the respective equipment and/or vehicle in a safe and efficient manner. NRT is an exception, with airside management vehicles coordinating their movements through apron control.

4.2.2 Airport Safety Management Systems

The development and implementation of SMSs at airports was identified in the data collection process as a key element in managing and controlling the movement of aircraft, equipment, and vehicles on the passenger terminal and air cargo apron areas. As such, all airports contacted indicated that they had developed and implemented an airport SMS in accordance with their respective state regulations and in accordance with the ICAO Standards and Recommend Practices (SARPs) regarding airport safety management. These regulations and SARPs require the airport to identify and evaluate all airport safety risks and hazards, including those associated with activities that occur on the passenger terminal and air cargo apron areas, and develop and implement mitigation plans that are designed to manage, mitigate, and control these risks and hazards. The mitigation plan clearly defines the airport's safety management policies and procedures and communicates safety-related standard operating procedures (SOPs). These SOPs specify how various airport activities, including those that occur on the apron areas, should be conducted in order to minimize and control the safety risks and hazards. A means of enforcing, monitoring, and measuring the effectiveness of these SOPs is also developed and implemented, along with a safety promotional program that is geared toward providing safety education and training to individuals working at the airport and communicating safety-related information.

With respect to SMS management and administration, all airports contacted, with the exception of Stockholm Arlanda Airport, indicated that a separate and distinct safety management unit had been created to develop, implement, and monitor the respective airport's SMS. In the case of ARN, the airport's administration is currently undergoing reorganization, and as such, the safety management unit will be dissolved and all safety-related matters will be handled by the individual airport units, divisions, and/or departments. Although safety management is still a top priority, airport management believes that the optimal way to fully integrate safety management into every aspect of the airport's operation is to make each airport unit, division, and/or department responsible for it.

As for the other airports contacted, the safety management unit, division, or department is responsible for identifying and evaluating all airport safety risks and hazards and developing viable mitigation plans that include clearly defined safety management policies and procedures as well as SOPs. They are also responsible for performing safety audits and inspections and for investigating accidents and incidents and maintaining related statistics. The actual implementation and enforcement responsibility for the safety-related policies, procedures, and SOPs typically rests with the unit, division, or department responsible for managing airside operations. This unit, division, or department is also responsible for reporting safety-related accidents and/or incidents to the safety management unit and for coordinating an appropriate response. Some airports, such as DUB, have delegated airside safety management to an airside safety manager who reports directly to the head of airside operations.

Regarding SMS implementation, most airports contacted indicated that their respective SMS had been incorporated into the airport's aerodrome manual (the equivalent of an airport certification manual as required in the United States). As such, the airport owner or operator is responsible for providing safe operating and work environments. The providing

of these environments is monitored by civil aviation regulatory authorities through routine inspections and audits of the airside safety environment. Most airports contacted indicated that they had developed and implemented specific SOPs for airside-related activities that occur in the apron areas and on the runways and taxiways. The apron-related SOPs address the safety aspects associated with the movement of aircraft, equipment, and vehicles, along with the operation of equipment on the apron areas during normal and adverse weather conditions such as strong winds and during winter and low-visibility operations. These typically address the following:

- Movement of aircraft: Brakes and chocks, pushback, multiple pushbacks, power back, towing, marshalling, stand preparation, emergency stop systems, stop short systems, jet blast, fumes, and noise.
- Movement of equipment and vehicles: Towbarless tugs, storage and staging of equipment and vehicles, equipment and vehicle condition, maintenance, marking and striping, and designated service and perimeter roads.
- Operation of equipment: Loading bridges, visual docking systems, 400-Hz power, preconditioned air, auxiliary power unit, and access to aircraft doors.
- Other: Signs, marking and guidance, wearing of highly reflective clothing, and use of hearing protection.

SOPs are normally detailed in the airport's safety management manual and referenced in its minimum operating standards. However, in the case of LHR and LGW, their respective SOPs are contained in a detailed airside safety management plan, which was developed and is implemented in accordance with the United Kingdom's Civil Aviation Authorities CAP 642 guidance document concerning airside safety management.

4.2.3 Airport Apron Regulations

Several airports contacted indicated that clearly defined and enforceable traffic policies and procedures, rules, and regulations were essential to minimizing the risks of accidents and injury to persons and damage to other vehicles and equipment, aircraft, and property.

International airports, such as ATH, DUB, LHR, LGW, AMS, PEK, CTU, and NRT, specifically reported the development and implementation of comprehensive traffic policies and procedures, rules, and regulations that address the following:

- Airside driving qualifications: The driver of a vehicle or the equipment operator must hold a valid, type-specific driver's license and a valid certificate of competence for that particular vehicle or equipment.
- Training and testing requirements: All vehicle drivers and equipment operators must undergo extensive airside driving training and participate in refresher training courses.
- Equipment and vehicle standards: All vehicles and equipment operating on the airside must be fit for their intended use, and their condition must be such that they do not endanger vehicle or equipment users, other vehicles or equipment, pedestrians, aircraft, or property. All vehicles and equipment operating on the airside must undergo regular and routine inspections in order to ensure compliance with the airport's equipment and vehicle standards and applicable motor vehicle and environmental standards.
- Insurance requirements: All vehicles and equipment operating on the airside must be properly insured to meet the airport's specific requirements.
- Equipment, vehicle, and driver identification: All vehicles and equipment operating on the airside must be properly marked, signed, lighted, and equipped with the necessary radio equipment. All vehicle drivers and equipment operators must be in possession of a valid airside badge and a driver's license that contains their photograph.
- Equipment and vehicle operation: All vehicles and equipment operating on the airside must operate only in areas where they are authorized to do so and must use only approved circulation routes and parking and storage areas. All vehicle drivers and equipment operators must adhere to published speed limits, vehicle and aircraft rights-of-way, and minimum setback distances. The vehicles and equipment must also adhere to height, length, and width restrictions.
- Night and low-visibility requirements: All vehicles and equipment operating on the airside at night must adhere to published night and low-visibility operational procedures.
- Equipment and vehicle reporting procedures: All vehicle drivers and equipment operators are required to report all accidents or incidents that occur on the airside to the airport and to the appropriate regulatory authority, such as the civil aviation, occupational health and safety, and environmental authorities. These accidents and incidents include but are not necessarily limited to accidents or incidents involving vehicles, equipment, aircraft, pedestrians, and property. Spills and releases of hazardous and nonhazardous materials must also be reported.

4.2.4 EU Liberalization of Ground Handling Services

In order to comply with applicable EU member state ground handling regulations and EC Directive 96/67/EC pertaining to the liberalization of the ground handling market within Europe, several airports, such as ATH, DUB, LHR, LGW, and

LIS, have created a separate and distinct airport ground handling unit, division, or department. This ground handling unit, division, or department is not only responsible for managing and coordinating daily ground handling operations but is also responsible for ensuring that minimum operating standards are met pertaining to delivery of baggage, aircraft turnaround times, response to complaints, training of staff, condition of equipment, and sharing of information. The ground handling unit is also responsible for maintaining open access to the airport ground handling market and for ensuring access to airport infrastructure. Management of the ground handling contracting process and resulting contracts is also the unit's responsibility, along with levying airport-related ground handling fees and monitoring quality management and control.

4.2.5 Eurocontrol Collaborative Decision-Making Process

All of the EU airports contacted indicated that they were also in the process of developing and implementing Eurocontrol's recommended collaborative decision-making (CDM) process and that their respective airport data management systems were the backbone of this process. The CDM process is composed of four different levels consisting of a series of the following:

- Level 1: Establishment of information sharing processes and procedures and the optimization of the aircraft turnaround process.
- Level 2: Determination of variable taxi times.
- Level 3: Development and implementation of collaborative predeparture aircraft sequencing processes in normal, peak, and adverse operating conditions.
- Level 4: Further refinement and enhancement of Level 3 elements.

The establishment of information-sharing processes and procedures is the foundation of the CDM process. This is achieved through the establishment of a memorandum of understanding (MOU) between the airport, air traffic service providers, airlines, and ground handlers specifying the terms and conditions and types of information to be shared along with the method for sharing. The airports' current data management systems provide the platform for this information exchange. The information is provided in real time in order to communicate the airport and air traffic conditions to all parties. This not only enables the parties to synchronize their operations in an effort to optimize the aircraft turnaround process, but it also allows them to determine predictable gate pushback times.

The proper sequencing of aircraft departures is an effective and efficient way to manage and control the movement of aircraft on the airport runway and taxiway systems and on apron areas. The benefits derived from this sequencing include decreased departure queues and efficient taxi routes, which results in reduced fuel burns and corresponding emissions. Pushback and departure times are communicated to all parties, including Eurocontrol's Central Flow Management Unit (CFMU), in order for them to properly plan and allocate resources and synchronize their respective operations.

In terms of classification, those airports that successfully implement Levels 1 through 3 attain the basic CDM status, while those that implement Levels 1 through 4 can attain the advanced CDM status. Only LHR and ZUR have successfully implemented the advanced CDM process, while all other airports contacted, with the exception of LUX and BLQ, have successfully implemented the basic CDM and are currently working to attain the advanced CDM process.

In 2003, ZUR was one of the first airports to implement the advanced CDM process, and it is currently considered an industry leader within Europe in the CDM process. A key element of ZUR's CDM process is the use of a suite of software systems (detailed in the following) that extracts harmonized and consistent data sets from the operating systems of the airport, air traffic service providers, airlines, and ground handling operators via a common platform, the airport's data management system. The information is then used by all parties to manage and control all airside activities, including those that occur in the passenger terminal and air cargo aprons.

The suite of systems currently in use at ZUR includes the following:

- FOCUS: An electronic flight strip system containing the information typically contained on a paper flight strip. This information is integrated into DARTS.
- DARTS: A system used to manage arriving and departing aircraft, helping determine the optimal arrival and departure runways and arrival and departure times. It is also used to determine the optimal pushback time and to optimize sequencing of aircraft arriving to and departing from the airport. This information is integrated into SALLY.
- SALLY: A system used to plan and optimize the use of airport resources such as aircraft gates and terminal processing functions (check-in counters, baggage handling systems, and baggage claim devices). This system also assists with the reallocation of these resources should operational conditions change. This information is integrated into AROSA.
- AROSA: An airport performance and monitoring system that is used to enhance the overall capacity of the airport. The system encompasses the complete aircraft turnaround process, including review of arrival and departure times, to determine the optimal airport operational strategies. Once employed, these strategies are monitored and performance is measured against expected results.

These systems are also in use at FRA and MUC. As part of ZUR's CDM process, the airport has established an airport operations center responsible for managing and coordinating daily operational activities, including those that occur on the passenger terminal and air cargo aprons. The center is staffed with representatives of the airlines (Swiss International Airlines), ground handling operators (Swissport), airport safety and security personnel, and personnel for the airport's flight operations, airport steering, terminal and air cargo operations, and logistics divisions. The center is managed by the airport steering division, and as such, the aircraft gate allocators and aircraft deicing coordinators are located in the center.

The purpose of the center is to accommodate all parties involved in airside-related activities, including those occurring on the passenger terminal and air cargo aprons, in a single central location to effectively and efficiently manage and control the movement of aircraft, equipment, and vehicles. This not only enables the airport to streamline and synchronize operational activities, but also allows it to respond to changing airport and air traffic conditions more readily. It also facilitates a collaborative decision-making process whereby daily airport operational decisions are collectively made by those parties directly controlling the various activities. The result is enhanced airport operational capacity, reduced operating costs, improved customer service, and minimized environmental impacts.

Similar airport operations centers have been established at all airports contacted. These centers are typically responsible for allocating aircraft gates and baggage handling systems, assigning check-in counters and baggage claim devices, coordinating the cleaning and maintenance of the apron areas and supporting systems, and coordinating snow removal activities and low-visibility operations. The centers also typically coordinate airport emergency response services. The only notable difference between ZUR's airport operational center and those centers in operation at the other contacted airports is the utilization of the operational centers. Specifically, ZUR uses its operational center to manage the entire airside, including those processes that are under the airport's direct control and those that are not, while the other contacted airports use their respective centers to manage only those airside processes that are under their direct control. As such, internal and external parties participating in the entire airside process at ZUR are located in the operations center, while only airside operational staff responsible for managing and controlling specific airport airside processes are located in the operational centers at the other airports contacted.

The use of a comprehensive airport data management system designed to provide a common airport-wide database and facilitate the sharing of relevant real-time data is vital to the successful management of aircraft, equipment, and vehicles operating on airport airside areas. All airports contacted indicated that such a system is used to manage and control airside-related activities, including those that occur on the apron areas. Specifically, the airports' data management systems provide the necessary platform for the collection and dissemination of relevant and real-time data among the various users, which include the airport, air traffic service providers, airlines, and ground handling operators. This information is used to plan and allocate resources such as assigning aircraft gates, determining the required number and location of ground support personnel and equipment, and synchronizing operations. The benefits derived from this information sharing and operational synchronization include increased airport capacities, improved operational efficiencies, safer working environments, and better utilization of airport infrastructure.

SECTION 5

Research Plan for Selected Airports

Based on the research scope in the amplified work plan, the information collected to this point in the project was used to select six U.S. airports and six airports outside the United States for which a more intensive investigation and data collection effort was conducted. These data and the insights that can be understood from the on-site visits and interviews were used to compare the effectiveness of apron management and control programs with different regulatory requirements and to evaluate the differences in approaches to apron management at airports within and outside of the United States.

Using the information collected to this point in the project, a matrix of apron management and control characteristics was developed for the U.S. airports and the airports outside the United States (Tables 5-1 and 5-2) given the differences in information collected and the overall approach to apron management and control. Each matrix was used to identify commonalities and differences among airports within the groups and to assist with the selection of the airports for the more detailed investigation. It should be noted that the matrices do not include the name or identifier of the specific airport so that individual airport information from the online survey is not released.

5.1 Airports Selected for Further Analysis

Based on the comparative matrix, seven airport respondents were selected by the project panel for more detailed analysis. For the U.S. airports, the project panel sought airports representing different types of apron control, specifically in the form of ramp tower operation: from airports without a ramp tower, to those with a single dominant airline with a ramp tower covering the majority of the apron area, to those with numerous airlines controlled by an airline or contract ramp tower. Notable safety programs or initiatives were also considered in selecting the seven candidate airports. The airports selected represent a mix of operational levels, hub classifications (three large and four medium hubs), and geography. While the research plan called for site visits to six U.S. airports, during the meeting with the project panel it was requested and the research team agreed to visit an additional (seventh) airport, Jacksonville International Airport, because this U.S. airport has developed an SMS. Table 5-3 presents the recommended U.S. airports for which detailed data collection and site visits were conducted.

Based on ACRP 04-07 Project Panel input, the research team focused on airports outside the United States with an apron control unit for consideration for the next phase of research. Consequently, five of the six airports recommended as candidates for further research have established apron control units in place. However, it was recommended that an airport without an apron control unit be included in an effort to make a comparison of accident/incident rates to those airports with apron control. Table 5-4 shows the six airports outside the United States recommended as candidates for further study.

5.2 Site Visit Process

The first step for the research team was to request participation in the study for data collection, the site visit, and coordination with the appropriate airlines and service providers (e.g., ground handling, fueling) at each airport. The research team contacted the airport representatives previously providing information to identify the necessary clearances and approvals to conduct the on-site observations, interviews, and data collection. Appendix B contains sample questions used to guide the discussions during the on-site visits. The typical site visit was conducted over 1 to 2 days and included interviews with airport staff from several departments, airline personnel (typically the station manager or safety manager), and personnel from ground handling companies, if applicable.

Table 5-1. Apron management and control comparison matrix for U.S. airports.

Apron Management and Control Characteristic	Airport A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Management of the apron area																	
Airport			■	■		■					■		■				
Airlines—at respective gates	■	■			■		■	■	■	■		■		■	■	■	■
Airport's regulatory authority																	
Local rules specific to the airport		■				■	■	■		■			■		■		
City ordinances				■												■	
State statute	■																■
Airline lease agreement			■		■				■		■					■	
Airline operating agreement											■						
Apron rules and regulations for apron operations	■		■	■		■					■	■	■			■	■
Responsibility for development of apron operating procedures																	
Airport	■		■	■		■			■		■	■	■			■	
Airlines					■		■	■		■	■				■	■	
Other																	■
Responsibility for compliance with apron operating procedures																	
Airport operations	■		■	■		■	■	■		■	■		■		■	■	■
Airport police	■									■			■				■
Airlines or tenants					■												
Frequency of apron regulation compliance or audits																	
Daily	■		■		■	■	■			■			■		■	■	
Continuous or ongoing				■				■			■						■
Apron control																	
Ramp tower	■			■	■	■	■	■	■						■	■	■
Uncontrolled		■	■							■	■	■	■	■			
Apron areas subject to control																	
All apron areas				■			■	■							■		
Parts of apron based on gate assignment	■				■	■			■							■	■
Aircraft and/or vehicles subject to apron control																	
Aircraft	■			■	■	■	■	■	■							■	■
Vehicles							■								■	■	■
Requirements for service providers operating on the apron																	
Training	■				■	■	■	■		■	■		■		■	■	■
Certification	■						■		■		■					■	■
Other				■	■	■											
Mandatory driver training for apron personnel	■		■	■		■	■	■	■	■	■				■	■	■
Hydrant fueling																	
All gates						■	■				■						■
Portion of gates	■		■	■	■			■	■	■						■	
No hydrant fueling		■										■			■		
Apron safety committee	■		■		■	■	■		■	■	■				■	■	
Safety initiatives or programs																	
FOD prevention	■		■			■	■	■		■					■	■	■
General safety awareness events/campaigns	■				■		■								■		
Winter operations safety										■							
Specialized training for aircraft maintenance personnel						■											
Implementation of SMS							■										
SMS encompasses apron area							■										
Standard procedures for reporting incidents and accidents	■				■	■	■	■	■						■	■	■

Source: ACRP Project 04-07 Online Airport Apron Management Screening Survey
Prepared by Ricondo & Associates, Inc.

Table 5-2. Apron management and control comparison matrix for airports outside the United States.

	Airport																						
Apron Management and Control Characteristic	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
National apron control regulation		■	■								■									■	■		
Direct adoption of ICAO Annex 14, Section 9.5											■									■	■		
National SMS regulations	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■	■
SMS requirement for ground handling companies				■				■															
National requirements for ground handling company certification		■	■		■			■	■		■		■		■					■	■		
Apron control unit	■	■	■			■	■				■					■			■	■	■		
Formal delegation of responsibilities of apron control unit and air traffic service provider	■	■	■			■	■				■								■	■	■		
Airport rules and regulations for apron regulations		■	■					■	■		■		■									■	■

Source: Ricondo & Associates, Inc. and Planport GmbH interviews
Prepared by Ricondo & Associates, Inc.

Table 5-3. U.S. Airports selected for further study and corresponding characteristics.

	Comparative Characteristics					
Airport	Hub Classification	Annual Operations (2010)	Apron Management Responsibility	Ramp Tower	Apron Regulations in Place	Notable Programs in Place
Baltimore/Washington Thurgood Marshall International Airport	Large	276,000	Airport	No	Yes	Monthly ramp safety meeting with airport and airlines
Chicago O'Hare International Airport	Large	879,000	Respective airlines	Yes—airline ramp tower	Yes	Monthly airside safety committee meetings and annual safety and wellness expo
Port Columbus International Airport	Medium	137,000	Airport	No	Yes	
Los Angeles International Airport	Large	575,000	Respective airlines	Yes—airline and contract ramp tower	Yes	
Oakland International Airport	Medium	221,000	Airport	No	Yes	
Jacksonville International Airport	Medium	96,000	Respective airlines	No	Yes	Early stages of SMS implementation
Lambert–St. Louis International Airport	Medium	187,000	Respective airlines	Yes—hub carrier	Yes	Ramp safety training requirement

Note: Salt Lake City International Airport was identified as an alternate airport.

Source: ACRP Project 04-07 Online Airport Apron Management Screening Survey; Ricondo & Associates, Inc.
Prepared by Ricondo & Associates, Inc.

Table 5-4. Airports outside the United States selected for further study.

Airport	Country	Annual Operations (2010)	Annex 14 Apron Control Unit Requirement	Apron Control Unit
Toronto Pearson International Airport	Canada	407,000	No	Yes
Beijing Capital International Airport	China	517,600	Yes	Yes
Madrid Barajas Airport	Spain	434,000	No	No
Zurich Airport	Switzerland	269,000	No	Yes
Dubai International Airport	United Arab Emirates	293,000	Yes	Yes
London Gatwick International Airport	United Kingdom	234,000	Yes	Yes

Note: Schiphol International Airport, Netherlands, was identified as an alternate airport.

Source: Ricondo & Associates, Inc.; Planport GmbH
Prepared by Ricondo & Associates, Inc.

SECTION 6

Limitations on Data Availability from the Site Visits

Through the site visit process, the research team encountered insurmountable difficulty collecting statistical data related to accidents and incidents in the apron area. This was a consistent theme throughout the site visits regardless of the type of organization—airport, airline, ground handling company, or fueling company. Many concerns were raised regarding the release of such data, how they would be used, comparisons and judgments that could be construed (or misconstrued) from the data, and privacy and legal issues.

In order to organize the interrelated reasons for the data availability and accessibility issues, the site visit discussions started with the reporting or collection of information immediately following an accident/incident. Through the site visit and interview process, the issue of data reporting was discussed with airports, airlines, and other service providers. The seriousness of each incident/accident typically dictates the level to which the event is reported. Many interview participants indicated that an event involving minor damage to airline equipment (excluding aircraft) may not be consistently reported by employees, although airlines typically expect employees to report all incidents. More serious equipment damage or minor injury to an employee is typically reported within the airline or service company but not necessarily to the airport. Official airport notification generally occurs if property damage is serious (including aircraft damage) or involves two companies, involves a fuel or oil spill, or results in an injury that requires emergency medical service response. While all airports included in the site visits and interviews have a requirement for event reporting, it was widely recognized that not all incidents and accidents are reported to the airport.

The research plan included collecting data from multiple operators and the respective airport with the intention of screening that data for duplication and ultimately forming a more complete picture of apron safety with the combined data. However, there was significant resistance to releasing any data of this type. Airlines consistently cited corporate policy that did not allow publicly releasing accident/incident data. This is consistent with the feedback received by the research team through contact with the Air Transport Association. Issues include privacy concerns for the airline and its employees and parties involved in accidents/incidents and the sensitive information that data reports may contain. This could include names, addresses, social security numbers, driver's license and airport identification numbers, and other sensitive information that, while not needed for research purposes, could be inappropriately used if released.

The other concern that respondents consistently conveyed to the research team relates directly to the purpose of this research and the comparison of the number or rate of reported accidents/incidents with that of other airlines. The collective airline concern is evidenced by the Air Transport Association's reaction to the *U.S. News and World Report* article entitled "America's Safest Airlines" (Jan. 31, 2011), which ranked the assessed safety of the eight largest U.S. airlines based on an analysis of documented incidents involving commercial U.S. passenger flights in 2010. The specific sources of the data used and the exact methodology to screen the data were not evident from the article, and the rankings were not limited to apron events exclusively but included all phases of flight.

Despite assurances that the research team would report and structure the data analysis in a manner that would not reveal the identification of individual companies or organizations, there was still concern that any data released to the research team could be acquired with a Freedom of Information Act (FOIA) request or other mechanism. Two airports expressed concern about this data reporting issue in the context of airport SMSs, which is the subject of a Notice of Proposed Rulemaking (NPRM) by the FAA. These airports reported that their comments on the NPRM included the

ability to fulfill a FOIA request for safety data collected and the need for confidentiality for the other reasons discussed here. The concerns were related to scenarios where potential legal claims on airlines or airports were filed as a result of disclosing safety data. This is one of the topics for which an ACRP project has been initiated. ACRP Project 11-01/Topic 04-02, "Legal Issues Related to Developing Safety Management Systems (SMS) and Safety Risk Management (SMR) at Airports," has as its stated objective "to produce a legal survey which could be used by attorneys advising airports in the implementation of SMS and the development of risk management systems under SMR."

Specific concerns expressed with providing accident and incident data included the following:

- Quality of the data collected (inclusiveness, overlaps, completeness, etc.);
- Underreporting of apron events and data associated with these events, particularly apron events occurring in leased airline areas;
- Airline refusal to voluntarily provide information, either individually or aggregated;
- Scrubbing of data necessary to eliminate duplications, resolve contradictory data, and other potential problems;
- Perceived risks associated with making the information available without being able to ensure its accuracy and completeness; and
- Limited usefulness and relevance if the database is not populated with sufficient information to allow users to analyze trends and otherwise mine the data for relevant and meaningful conclusions.

Only two of the airports included in the site visits, both in the U.S., provided limited data as part of the online data survey. Without access to accident and incident data from the remainder of the site visit participants, and lacking confidence that the reported/summarized data presented a complete or accurate picture of the actual occurrence of apron incidents or accidents, statistical correlations documenting the relationship between apron control programs and the occurrence of accidents and incidents is not possible. The following sections of this report summarize the apron control attributes of the airports for which site visits were conducted, including the parties responsible for apron-related functions, apron safety initiatives, operating regulations, and reporting procedures. This is followed by a comparison of those attributes for the airports in the United States and those outside the United States.

SECTION 7

U.S. Airport Site Visits

Each of the seven airports identified by the research team and the project panel agreed to participate in the site visit and interview process for the study. The sections that follow present a summary of airport physical characteristics (gates, linear frontage of aircraft parking, etc.) and descriptions of apron control, apron safety initiatives or programs, and reporting procedures for apron incidents and accidents.

7.1 Baltimore/Washington Thurgood Marshall International Airport

The site visit for Baltimore/Washington International Thurgood Marshall Airport (BWI) was conducted on December 14 and 15, 2010, by a member of the research team. The site visit included a driving tour of the apron area and meetings with several representatives of the operations department and personnel responsible for risk management within the airport. Interviews were also conducted with representatives from two airlines and a ground handling and fueling provider. Additionally, the site visit included the opportunity to attend and observe the airport's monthly apron safety meeting. Some key facts about the airport and the apron include:

- Owned and operated by the Maryland Aviation Administration.
- Annual aircraft operations: 276,000.
- 4 terminals, 5 active concourses.
- Aircraft gates/parking positions: 74.
- Leased gates are preferential use; vacant gates are common use.
- Aircraft parking linear frontage: 11,600 ft.
- 13 airline operators.

Apron Description

Exhibit 7-1 provides an overview of the airport apron areas. As shown, the terminal is configured as a series of connected unit terminals with six pier concourses. Along concourses A and B on the west side of the terminal area, aircraft push back from the gate directly into the movement area. For all other gates, aircraft push back within the apron area and taxi to the movement area. Vehicle service roads are marked on the apron behind the aircraft parking positions.

Apron Control

Airport operations uses an apron tower that is centrally located in the terminal complex. This facility is primarily a monitoring position and does not provide aircraft control functions. Cargo parking positions and remain-overnight parking positions are assigned by operations. US Airways operates an apron tower that is limited to covering the airline's gates on Concourse D along with an adjacent gate operated by a different airline. Southwest Airlines has an apron operations center located on the apron level of their concourse. This center coordinates activities of the gate agents, baggage handling, and personnel assignments by gate but does not provide aircraft control functions. Aircraft push back from the gate under the guidance of ground marshals and contact air traffic control (ATC) ground control.

Safety Initiatives and Training

Apron safety regulations instituted by the airport include a requirement for high visibility clothing (also a requirement of the individual airlines operating at BWI) and restrictions on cell phone/smart phone use in the apron area. Driver training for the apron area is included with the training required for issuance of a Security Identification Display Area (SIDA) badge. Additional training is required for driving in the movement area (runways and taxiways), and the airport has also instituted a separate endorsement for aircraft towing.

The BWI operations department holds a monthly ramp safety meeting for airport departments, tenants, ground

Exhibit 7-1. Baltimore/Washington Thurgood Marshall International Airport apron layout.

Source: Google Earth

handling providers, and other tenants. The purpose of this meeting is to inform attendees of current activity in the ramp area such as construction or maintenance, to discuss safety issues, and to increase awareness of a safe work environment. In addition to airport operations, police and fire fighting personnel, all airlines, ground service providers, and fueling providers are invited to attend the meetings. The meetings serve to raise awareness about safety in the apron area, emphasize the priority placed on safety in the movement and non-movement areas, and highlight responsibilities for the safety of these areas. This open forum allows for issues to be put forward by anyone in order to seek feedback on a solution. This could range from apron vehicle speeding issues to discussions about FOD and the responsibilities to ensure that it is contained.

At BWI each airline is responsible for painting the apron pavement with applicable markings as required by their company policies. For common-use gates, the airport is responsible for the apron markings. In general, only basic apron markings were observed, with no airline identifying GSE storage or staging areas with ground markings.

Reporting

Airport operations personnel are dispatched to an event either by the operations control center (if observed from the control center) or by public safety dispatchers who receive reports of events by phone or radio. These can be landside, terminal, or airside events, which includes the apron area. For each event, operations staff complete an incident report. The incident report can be supplemented by a police or fire report if either or both of those departments respond. The incident reports are submitted to the airport's risk manager, who initiates any follow-up activities related to airport claims.

7.2 Chicago O'Hare International Airport

The Chicago O'Hare International Airport site visit took place on October 27, 2010, with two research team members attending meetings with airport operations, safety, and property management. Follow-up meetings were held with two airlines on December 1 and 3, 2010. Additionally, the site visit included the opportunity to attend and observe the airport's monthly Airside Safety Committee meeting. Some key facts about the airport and the apron include:

- Owned and operated by the City of Chicago Department of Aviation (CDA).
- Annual aircraft operations: 879,000.
- Four terminals, nine concourses.
- Aircraft gates/parking positions: 189.
- All gates except one are preferential use in the domestic terminal; all gates are common use in the international terminal.
- Aircraft parking linear frontage: 22,500 ft.
- 37 airline operators.

Apron Description

Exhibit 7-2 provides an overview of the airport apron areas. On the west side of the apron area, there is enough room for service roads behind aircraft parking positions. The rest of the apron area is more space constrained and does not include a service road behind all aircraft parking positions. A service road encircling the entire apron area delineates the interface between the movement and non-movement areas, with the apron areas classified as the non-movement areas. Transition into the movement area requires communication and clearance from ATC. Transition into the non-movement area does not require any communication with ATC, although communication with the ramp tower may apply. The majority of GSE staging activity at O'Hare takes place around the gate area. The majority of gates at O'Hare are equipped with hydrant fueling systems.

Apron Control

There are six ramp towers in place in the terminal area; four are operated by the hub carriers at the airport and two by contract operators, including the ramp tower serving Terminal 5, which handles international operations. The ramp towers are primarily responsible for coordinating the movement of aircraft for all airlines on the ramp. Aircraft contact FAA ground control and must receive clearance before entering the movement area.

In the international terminal area, an international gate coordinator assigns parking positions to arriving aircraft and coordinates pushbacks onto the taxi lane or taxiway, as applicable. This coordinator also directs aircraft that have completed the deplaning and servicing process from gates to remote hardstand parking positions in the non-movement area when the gates are needed for subsequent flights.

Safety Initiatives and Training

The Airside Safety Committee meets monthly; it includes representatives from the airlines operating at the airport, the FAA air traffic control tower (ATCT) and Flight Standards District Office (FSDO), ground handlers, the CDA Operations Division, the CDA Facilities Division, the Chicago Police Department, the Chicago Fire Department, TSA, the Airline Pilots Association (ALPA), and so on. Safety incidents, investigations, resolutions/suggestions are discussed openly.

An annual safety and wellness expo is organized for airport employees. This event, in its 17th year, features new safety and health products that pertain to the airport environment and is intended to increase overall awareness of safety in the operating environment. The health and wellness component was added to the expo 2 years ago.

CDA operations also coordinates a FOD working group that is collectively developing best practices specific to the airport. The FOD working group sponsors spring and fall cleanup events in the apron area and periodic FOD walks on the apron. As another example of the ongoing attention paid to operational and apron safety, one airline indicated that it has painted one of its vehicles green with a "FOD Squad" logo to raise FOD awareness among its employees and encourage employee vigilance when FOD is found in the operating environment.

CDA has a ground vehicle operating regulation in place that covers all rules for vehicle operations on the airport, including the apron. The CDA Security Division is responsible for enforcing the vehicle regulations and issuing citations for violators. The penalties are monetary fines; an adjudication process is available to appeal the citation. Failure to pay the fines results in SIDA access privileges being revoked.

Exhibit 7-2. Chicago O'Hare International Airport apron layout.

Source: Google Earth

All CDA employees and CDA-contracted employees working on the apron area (and the movement area, if necessary) must complete an airfield driver training course and pass a written exam. Airline and ground service providers are responsible for their own training for their employees on apron driving and operating procedures, but the CDA exam must be passed prior to the issuance of driving privileges. The training and exam include identification of hazards on the apron area, apron marking and signage, use of safety vests and hearing protection, and the need for heightened awareness in the apron area. The exam includes questions based on the specific rules outlined in the ground vehicle operating regulations.

Reporting

Events are reported to the airport's Operations Control Center (OCC). OCC dispatches public safety units depending on the nature of the event. Additionally, the Chicago

Police Department is responsible for responding to and investigating airport accidents and incidents. The police report is the official record of the event and is used by the airport for follow-up investigation and if insurance claims are involved.

7.3 Jacksonville International Airport

On December 7 and 8, 2010, two members of the research team conducted the site visit for Jacksonville International Airport. This site visit included meetings with aviation management, operations, and risk management to discuss the SMS implications on apron management. Additionally, interviews were held with four airline station managers or safety managers and the fixed-base operator (FBO) operating at the airport. Some key facts about the airport and the apron include:

- Owned and operated by the Jacksonville Aviation Authority.
- Annual aircraft operations: 96,000.
- One terminal, two concourses.
- Aircraft gates/parking positions: 20.
- All gates are preferential use.
- Aircraft parking linear frontage: 2,400 ft.
- Eight airline operators.

Apron Description

The apron and concourses at Jacksonville International Airport were recently redesigned and rebuilt, optimizing aircraft and vehicular access to the gate areas. At the apron level, vehicular service roads pass beneath the concourses in two locations to reduce driving distances. The new apron design also provides ample GSE staging space. Several remote aircraft parking positions are in close vicinity to the terminal. Exhibit 7-3 provides an overview of the airport apron areas.

Apron Control

The airport does not have an apron control tower in use. Individual airlines control their operations from apron-level facilities and on the apron itself. Occasionally, workload permitting, ATC may provide advisories on potential traffic conflicts for aircraft operating in the apron area. The airport enforces its operating regulations and coordinates tenant issues through operations personnel on the apron. Additionally, airport operations monitors gates with cameras, which were noted to be especially useful in investigating accidents and incidents. The airport indicated that the number of cameras in use will be tripled in the near future.

Safety Initiatives and Training

Jacksonville International was selected because the airport has instituted a safety management system prepared as part of the FAA's pilot program. The SMS includes the airfield, apron, terminal, and landside areas. An SMS form is available to report an accident or potentially hazardous behavior or condition at the airport. The form may be mailed, emailed, or submitted online. Events can also be reported by phone. The form may be submitted anonymously if desired, although contact information is useful for any follow-up actions. While it has not yet resulted in changes in procedures, implementing the SMS has raised awareness of safety in the day-to-day work environment. Because the required SMS structure has not been finalized by the FAA, at this point it is unclear how an airport SMS will affect airline-specific SMSs and other safety programs and how these organizations will be reporting apron incident and accident data to one another.

The Airport Safety Committee meets monthly and includes participation by airport departments and tenants. The SMS program is incorporated in this meeting. These meetings discuss events in an effort to identify any triggering causes and to correct any hazardous situation that is identified. Additionally, monthly FOD walks are conducted with tenants and vacuum trucks operated by the airport. An annual safety fair is held where vendors present products designed to enhance safety in the apron area.

Reporting

Accidents and incidents are reported to the Airport Operations Control Center. The airport is currently using its existing spreadsheet-based incident reporting system; however, it is developing a reporting software that can be used as part of the SMS to achieve refined tracking of occurrences, trends, and costs. More reporting is expected as the safety culture at the airport matures and SMS becomes more widely understood.

7.4 Lambert–St. Louis International Airport

Two members of the research team conducted the site visit at Lambert–St. Louis International Airport over December 14 and 15, 2010, which included meetings with airport operations and the airport risk manager. A site tour of the apron was provided to review the physical characteristics. In addition, interviews were conducted with representatives from four airlines and one fuel service provider at the airport. Some key facts about the airport and the apron include:

- Owned and operated by the St. Louis Airport Authority.
- Annual aircraft operations: 187,000.
- Two terminals, three concourses.

Exhibit 7-3. Jacksonville International Airport apron layout.

Source: Google Earth

- Aircraft gates/parking positions: 42.
- All gates are preferential use.
- Aircraft parking linear frontage: 5,600 ft.
- 14 airline operators.

Apron Description

Exhibit 7-4 provides an overview of the airport apron areas. The apron has a long and narrow configuration, creating several operationally constrained areas. Concourses B, D, and a portion of Concourse C are vacant. As a result, the apron area adjacent to Concourse B is used for remote aircraft parking or GSE storage. Several gates require aircraft to push back onto an active taxiway when departing, creating safety concerns and potential delays to the departing aircraft. Hold pads are located within the apron area and may be used for deicing aircraft. Gates are equipped with a fuel hydrant system.

Exhibit 7-4. Lambert–St. Louis International Airport apron layout.

Source: Google Earth

Apron Control

The only form of apron control is provided by the air traffic control tower to Delta Airlines aircraft pushing back from the gate since this operation causes the aircraft to enter the movement area. All other activities are controlled by individual airlines from apron-level facilities in their respective gate areas.

Airport operations, occupying the vacated ramp control tower on Concourse B, maintains an around-the-clock presence in generally monitoring activities in the movement and non-movement areas. In this way, operations is aware as much as possible of activities and events in the apron areas. Operations also serves as the liaison between the airlines and the departments within the airport and can get involved with apron incidents and accidents when they are made aware of such events or observe them from the ramp control tower. Airport operations and the air traffic control tower have apron video cameras to monitor apron activity; although these cameras can zoom in, they do not have recording capability.

Safety Initiatives and Training

The airport holds monthly safety meetings with the airlines and ground handlers. Primarily, these meetings cover changes in regulations, construction activities that may affect operations, and reviews of safety-related or potential problems occurring in the apron environment (vehicle infractions, GSE parking/staging, etc.). In addition to the safety meetings, airport operations personnel conduct regular inspections of the apron area to identify potential hazards and notify the appropriate tenant or airport department to remedy the problem.

The airport has a safety plan for severe weather such as high-wind conditions during tornadoes. Airlines conduct safety drills internally, with occasional participation of airport divisions. There are live public address systems in the terminals to direct passengers and employees to the baggage claim area during severe weather conditions.

In addition to the SIDA training, apron driver training is conducted by airport operations for the initial driver certification and by an airline instructor for recurrent training. Violations of driving regulations can lead to a citation or immediate disciplinary action such as revocation of apron access privileges. Additionally, airport operations monitors the airlines' safety programs.

Reporting

Accidents and incidents are directly reported to airport operations by the airport dispatcher following a medical or police notification event. Operations specialists complete an investigation form following response to accidents and incidents in the apron area. Data included on these forms can be used to track trends, identify problem areas, and recommend changes in operating procedures. Airlines typically report internal events (within the airlines' leased areas) when significant airport equipment or structural damage is involved. Internal airline events are not tracked by the airport. Airport employees are encouraged to ask questions and report anything unusual; reporters may be rewarded.

7.5 Los Angeles International Airport

For Los Angeles International Airport, the site visit was conducted on December 9 and 10, 2010. In addition to meeting with airport operations staff, a review of the apron area was provided by vehicle. The research team member conducting the site visit also met with the contract operators of two of the airport's terminals and one airline safety manager. Following the site visit, phone interviews with two other airlines' station managers were conducted. Some key facts about the airport and the apron include:

- Owned and operated by Los Angeles World Airports.
- Annual aircraft operations: 575,000.
- Nine terminals, nine concourses.
- Aircraft gates/parking positions: 143.
- Mix of common-use and preferential-use gates.
- Aircraft parking linear frontage: 14,300 ft.
- 25 airline operators.

Apron Description

Exhibit 7-5 provides an overview of the airport apron areas. The terminal area consists of nine unit terminals in an extended "U" configuration. Each terminal has a single pier concourse, with the exception of the Tom Bradley International Terminal (TBIT), which currently has two single-loaded pier concourses but is undergoing expansion that will provide gates on both sides of the two piers (double-loaded). Vehicle service roads are not marked on the aprons, and drivers must use discretion and vigilance in traveling among gates and avoid traveling into the aircraft parking limit lines.

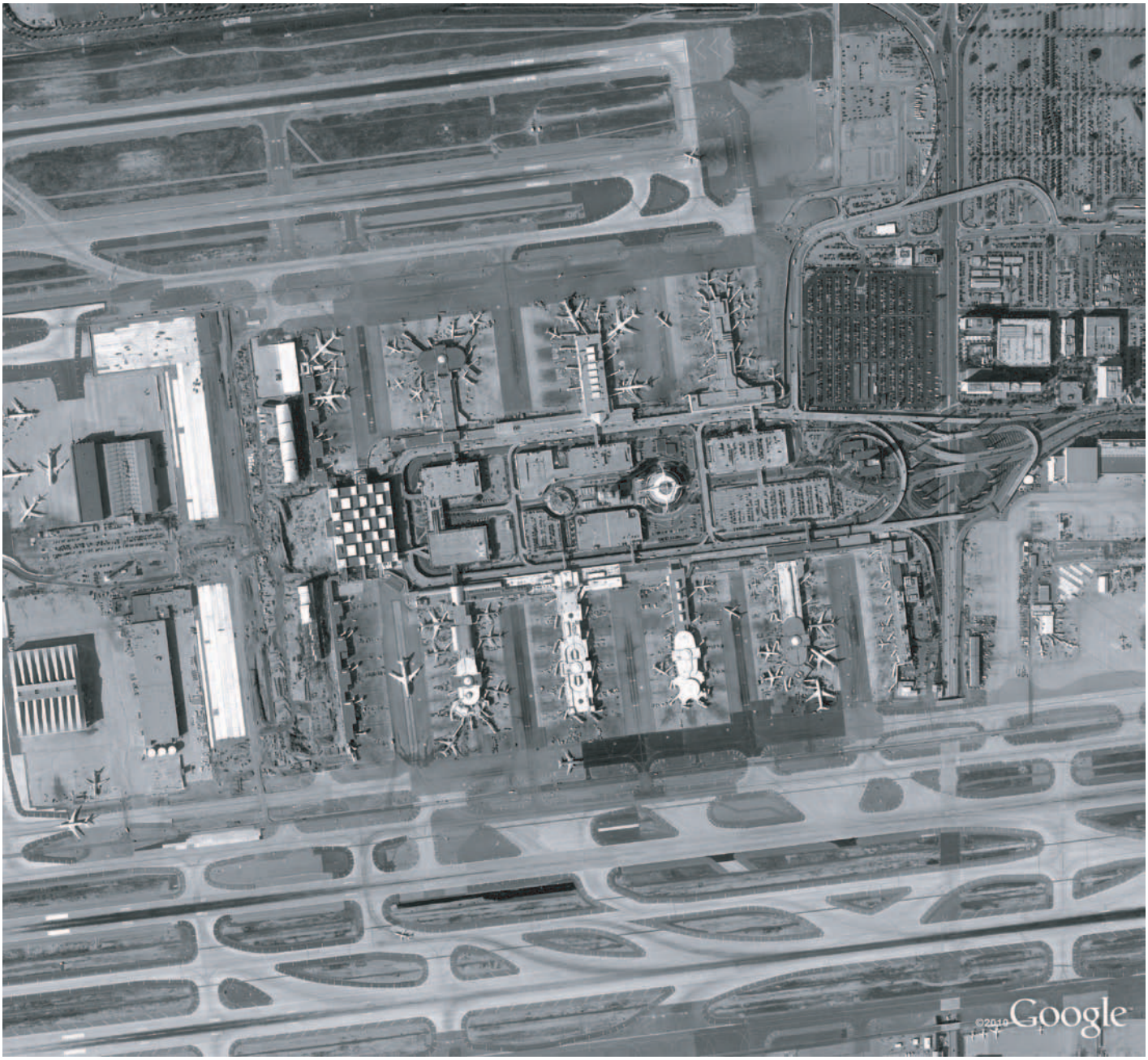
Apron Control

The terminal complex at LAX consists of nine concourses each with differing levels of apron control, ranging from no ramp tower to airline-operated apron control towers. Where no ramp tower is used, operations are controlled by ground personnel on the apron. Airport operations coordinates the gate assignments for the common-use gates in TBIT, Terminals 3 and 6, and the west gates. For airlines with a larger number of operations at LAX, ground handling is performed by airline personnel. For airlines with a smaller number of operations, such as foreign-flag carriers with one or two daily flights, ground handing is contracted to a third-party provider that must be approved as meeting the insurance and operating requirements of the airport.

Safety Initiatives and Training

Several interview participants identified issues with ground service equipment as an apron management issue. These issues were generally related to either the volume of vehicles and equipment in the apron area or inoperable or defective ground equipment. In the TBIT, for example, gates are not leased exclusively or preferentially, but rather operated as common-use facilities. Consequently, airlines that operate at the TBIT gates contract for ground handling services with

Exhibit 7-5. Los Angeles International Airport apron layout.



Source: Google Earth

one of several providers approved to provide these services at LAX. One service provider often does not handle consecutive flights at the same gate. The time required to move full sets of aircraft servicing equipment from gate to gate typically does not allow for efficient servicing schedules. Therefore, multiple sets of aircraft service equipment, owned and operated by different service providers, are frequently staged on the apron around each gate. This practice constrains the area available for the safe and efficient movement of each ground service provider's aircraft service vehicles/equipment into place for servicing scheduled aircraft and for workers on the apron. As of the date of this report, the contract operator of the TBIT and the airport have investigated the benefits of providing a common complement of aircraft ground handling equipment at each gate for use by each service provider that has responsibility for handling an aircraft at each gate to reduce the duplication of equipment and the resulting congestion it causes.

To address the inoperable or defective ground equipment, the airport instituted the Ground Equipment Inspection Program (GEIP). This program has two main components: periodic training on safety awareness around aircraft servicing ground equipment and regular inspections of the apron area to identify servicing equipment in need of repair or removal. Once identified through the GEIP, a vehicle/piece of equipment receives a blue tag and the vehicle/equipment owner has 72 hours to correct the problem(s). If the tagged vehicle is not repaired or removed from service within the allowable timeframe, a red tag is affixed and the vehicle/equipment is escorted to the owner's leasehold area. If a vehicle or equipment with a red tag is observed operating in the apron environment, it is impounded by the LAX police department until the problems are remedied and associated fines are paid.

Additionally, the airport works with airlines on gate-specific taxi-in/taxi-out procedures that take into account the physical constraints of the apron within that part of the terminal and the impact of different aircraft types on adjacent gates, regardless of lease type (common use or preferential use). This is done to enhance apron safety by defining the operating parameters by aircraft type, aircraft at adjacent gates, and taxi-lane restrictions. This also ensures that the parking configurations of one airline do not adversely affect gates that are operated by other airlines.

Driving training is required for any individuals driving vehicles or operating equipment in the apron environment. This is conducted in conjunction with the SIDA training, and the driver endorsements are identified on the employee's SIDA badge. To obtain the driver endorsement, an employee must undergo 8 hours of supervised in-vehicle training and pass a written exam. An Aircraft Surface Movement Program endorsement is also required for towing aircraft. In addition to airline or ground handling company training on towing equipment and procedures, an airport-provided classroom training program and successful completion of a written exam are required.

Apron vehicle and equipment operating regulations are enforced by the LAX police department and airport operations as part of the LAX Security and Airfield Enforcement Program. Upon observing an infraction, police officers issue a Notice of Violation. Additionally, airport operations can issue a Notice of Safety Infraction for aircraft, vehicle, fueling, or other operations that are in violation of the airport's regulations. Supervisors are required to sign and return the notice along with a description of corrective actions taken. Additionally, the employee cited must attend a corrective training program in the area specific to the violation: security, driving, or towing/pushback. Points are accumulated for each violation (depending on the severity of the infraction) and driving privileges suspended if a specified number of points accumulated in a 1-, 2-, or 3-year period is exceeded.

Reporting

Events are reported to the Airport Operations Center (AOC) by phone or radio, depending on the person making the report. The AOC dispatches appropriate personnel to the accident/incident, including airside operations personnel. Events reported are logged by airside operations into a database for use in any subsequent investigation and for reviewing accident and incident trends.

7.6 Oakland International Airport

The Oakland International Airport site visit took place on January 17 and 18, 2011. Several members of the airport's operations department participated in a discussion on apron management, and there were individual interviews and a site tour that included all of the apron areas. In addition to airport personnel, the research team member met with and interviewed representatives from two airlines, a ground handling service provider, and the fuel service provider for the airport. Some key facts about the airport and the apron include:

- Owned and operated by the Port of Oakland.
- Annual aircraft operations: 221,000.
- Two terminals, two active concourses.
- Aircraft gates/parking positions: 31.
- All gates are preferential use.
- Aircraft parking linear frontage: 4,260 ft.
- 12 airline operators.

Apron Description

Exhibit 7-6 provides an overview of the airport apron areas. With two concourses, the apron area is generally divided between the concourses, which provide the pushback area from the gates and access to the airfield, and the area west of the concourses, which serves the westernmost gates and provides a combination of parking positions for remote parking of both passenger and cargo aircraft.

Apron Control

The airport does not have an apron control tower. Individual airlines control their respective operations from apron-level facilities and on the apron itself. The airport has operations personnel that patrol the apron area to monitor compliance with the airport's regulations. An airport operations office serves as the point of contact for use of the common-use remote parking positions and gates and schedules the allocation of these positions.

Exhibit 7-6. Oakland International Airport apron layout.

Source: Google Earth

Safety Initiatives and Training

Like other airports, driving training for the apron (non-movement) area is incorporated with the SIDA training courses, and additional training is required before driving is allowed on the movement area.

The regulations that govern conduct on the airport, and specifically in the apron area, were recently overhauled and adopted by the Port of Oakland's Board of Commissioners. To address immediate concerns, the airport can issue a directive to its tenants and operators to raise awareness of a specific problem and require action to correct the problem. If a directive needs to be incorporated into the airport regulations, the change is recommended to the Board of Commissioners for approval.

Airport operations is responsible for monitoring activities within the apron area, identifying infractions to the published regulations, and issuing citations. If an individual receives three citations in a 12-month period, the SIDA badge can be revoked or the apron driving endorsement removed.

As part of monitoring apron operations, writing citations, and responding to incidents or accidents, airport operations has identified hot spots, or areas that require added attention from drivers and equipment operators, and uses its directive program to raise awareness of these areas.

Reporting

Airport operations responds to accidents and incidents along with police, aircraft rescue and fire fighting (ARFF), or EMTs, as necessary. As with other airports, these events are most often reported by phone from airport employees. An incident report is prepared and incorporated into the airport's Part 139 tracking and reporting software.

7.7 Port Columbus International Airport

The site visit at Port Columbus International Airport was held on January 25, 2011. Airport operations participated in site visit interviews and provided the research team member with a review of the apron area by car. The site visit also included meetings and interviews with representatives from three airlines and the FBO at the airport that provides fueling services to a number of the airlines. Some key facts about the airport and the apron include:

- Owned and operated by the Columbus Regional Airport Authority.
- Annual aircraft operations: 137,000.
- One terminal, three concourses.
- Aircraft gates/parking positions: 37.
- Leased gates are preferential use; vacant gates are common use.
- Aircraft parking linear frontage: 5,000 ft.
- Nine airline operators.

Apron Description

Exhibit 7-7 provides an overview of the airport apron areas. The terminal complex is located between the parallel runways at the airport and is made up of three concourses. The apron surrounding the concourses is designated as a non-movement area, and ATC clearance is required to taxi from the apron to the taxiways. The vehicle service road is located at the tail of the aircraft parking positions around the apron.

Apron Control

The airport does not have an apron control tower in use. Individual airlines control their operations from apron-level facilities and on the apron itself. The airport monitors apron activities through operations personnel in vehicles on the apron who enforce airport regulations.

For common-use gates and unassigned gates, airlines contact the operations department to schedule use of these assets on an as-needed basis. Typically this occurs when an aircraft with a mechanical or other problem occupies a gate longer than scheduled, during periods of irregular operations, or for overnight aircraft parking.

Safety Initiatives and Training

Regulations covering operations and safety in the apron environment are enforced through the operations department and airport police. A Notice of Violation is issued when an infraction is observed. The airport's regulations include penalties for violations, including monetary fines, suspension and/or revocation of driving privileges on the apron, and in some cases immediate confiscation of the SIDA access badge.

Changes to the airport's apron operating regulations are proposed by airport operations when operating conditions change or if issues arise for which regulations need to be clarified or expanded. The changes are coordinated through the legal department and are presented to the Airport Authority Board for consideration and approval.

Safety awareness is emphasized though the airport's "Community Reminder" publications distributed to all tenants. These cover a wide range of topics such as safety in the winter season, construction reminders, tornado preparedness, and FOD control. The airport also works with tenant airlines to hold a spring cleanup to raise FOD awareness.

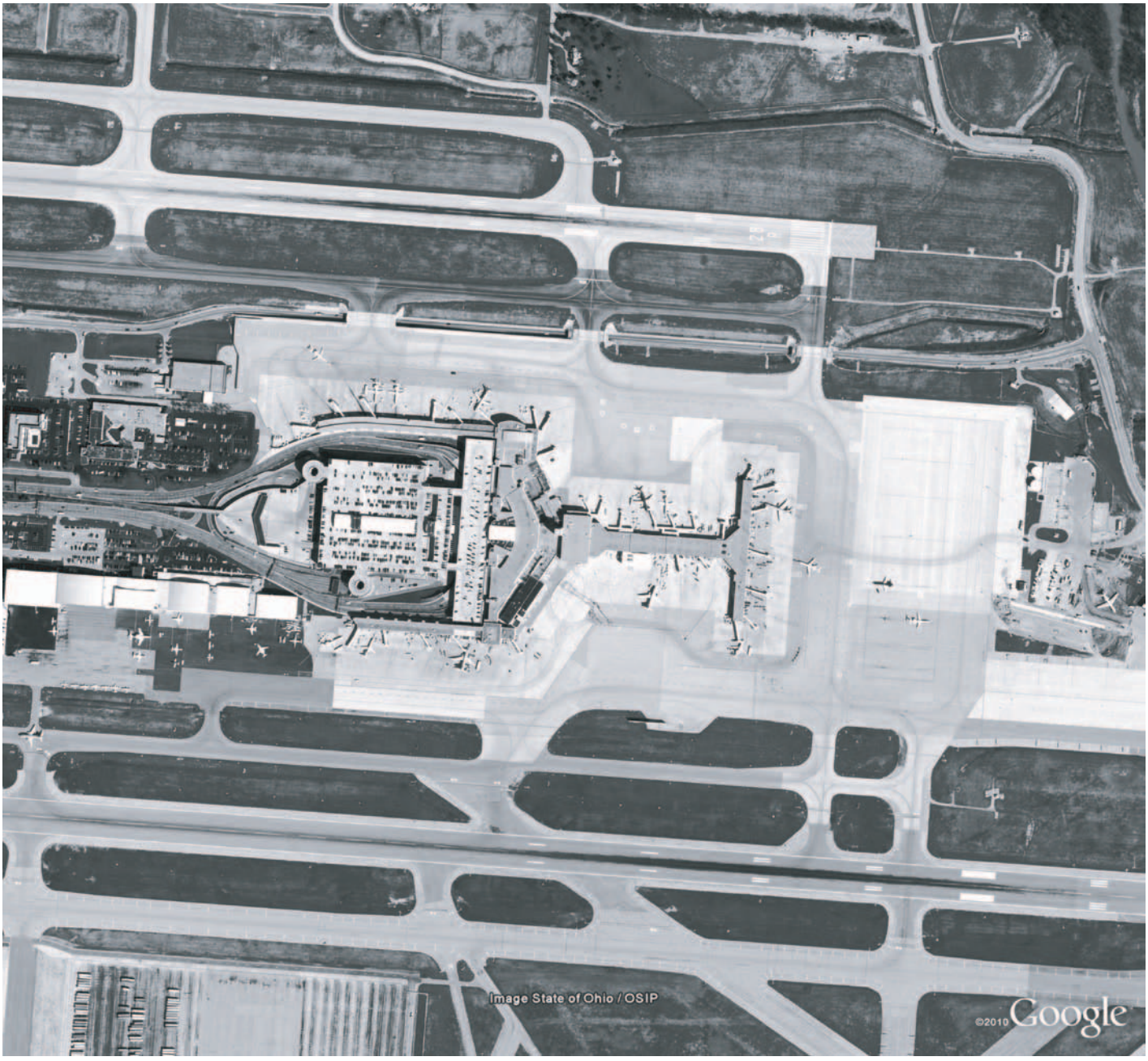
It was noted that winter operations have a tendency to compound safety issues, and deicing-specific meetings are held to coordinate the activities at the central deicing pad. Each airline is responsible for its own deicing operations or contracts with a deicing service provider.

Airport operations personnel have identified lookout areas around the apron at some service road intersections and turns into terminal tunnels where extra attention should be paid by vehicle operators. These areas are brought to the attention of tenants through the "Community Reminder" publications.

The airport does not inspect ground service equipment that is owned and operated by airlines or aircraft ground servicing/handling companies. The accumulation of derelict or otherwise nonfunctioning equipment has not been identified as an issue at this time.

Apron employees are required to take an initial driver training course and pass an exam for an endorsement on the SIDA badge to allow driving in the apron environment. Recurrent training is required every 2 years after the initial training. A separate driver training program and endorsement are required for driving privileges in the movement area.

Exhibit 7-7. Port Columbus International Airport apron layout.



Source: Google Earth

Tenants are required to stripe and mark the apron in the gate areas under lease. Any revisions to the striping and marking plan must be reviewed and approved by the airport to ensure compatibility with surrounding gates.

Reporting

The reporting process begins with notification of an event to the airport communications center by phone from airport tenants or by radio by airport operations if they witness an event. Depending on the nature of the event, police, emergency medical technicians, and/or ARFF can be dispatched to the scene along with operations personnel. Operations personnel use a separate incident report that is considered the official internal report. This report is separate from but parallel to the police, EMT, or ARFF reports that are prepared for those specific departments.

SECTION 8

Site Visits at Airports Outside the United States

Of the six airports outside the United States identified for site visits by the research team and the project panel, two elected not to participate in the site visit phase of the study when approached during this phase of the research: Madrid Barajas Airport and Dubai International Airport. Two alternate airports were contacted by the research team, Schiphol International Airport (identified as an alternate by the project panel), and Abu Dhabi International Airport (not previously identified as an alternate airport but having similar characteristics as Dubai International Airport). Unfortunately, both of these airports declined the opportunity to participate in the site visit phase of the study as well. The sections that follow are structured to parallel the findings reported for the U.S. airport site visits with a summary of airport physical characteristics (gates, linear frontage of aircraft parking, etc.) and descriptions of apron control, apron safety initiatives or programs, and reporting procedures for apron incidents and accidents.

8.1 Beijing Capital International Airport

Two members of the research team conducted the site visit at Beijing Capital International Airport on November 2 and 3, 2010. A walkover of a portion of the Terminal 3 apron and a vehicular tour of portions of the aprons around Terminals 1, 2, and 3 were provided during the visit. The team met with airport personnel from both the airside operations department and the apron control group within that department. Additionally, interviews were conducted with representatives with two airlines and a large ground handling company that serves airlines at Beijing Capital International Airport as well as other airports in China. Some key facts about the airport and the apron area include:

- Owned and operated by the Beijing International Airport Co., Ltd.
- Annual operations: 517,600.
- Three terminals, seven concourses.
- Aircraft gates/parking positions: 172.
- All gates are common use.
- Aircraft parking linear frontage: 26,500 ft.
- 80 airline operators.

Apron Description

Exhibit 8-1 provides an overview of the airport apron areas. Terminals 1 and 2 are located between the west set of parallel runways. Terminal 3 is located between the east set of parallel runways and opened in 2008. Terminal 1 has two pier concourses, while Terminal 2 has four piers connected by a central concourse. Terminal 3 is made up of three concourses that are aligned so that functionally it operates as one continuous concourse. Remote hardstand positions are located around all three terminals. Terminal 3 is notable in that the only vehicle service road is located between the aircraft parking positions and the face of the concourse. Terminals 1 and 2 have a vehicle service road at the tail of the aircraft parking position as well as in front of the positions adjacent to the terminal.

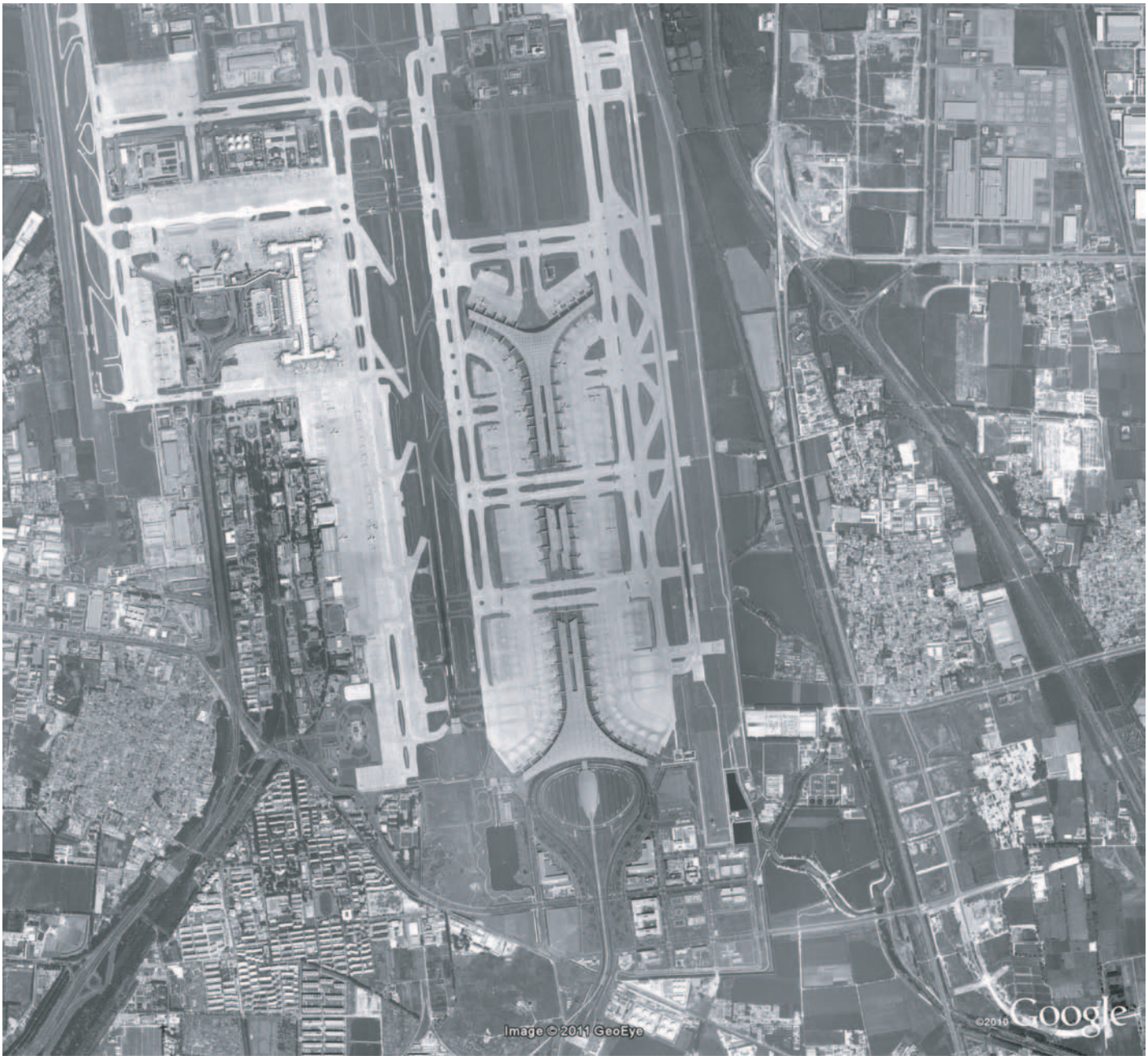
Apron Control

Beijing Capital Airport Authority manages the apron through its apron control group within the airfield management department. Each of the three main terminals is served by an apron control unit that provides aircraft movement control on the apron, assignment of gates, which are all operated as common use, and assignment of the common-use terminal functions of ticketing and baggage claim.

Safety Awareness and Training

Officials from the airport identified two key factors in their approach to safety for the airport and in the apron area. The

Exhibit 8-1. Beijing Capital International Airport apron layout.



Source: Google Earth

first was continuous coordination among government agencies, the airport, airlines, service providers (including ground handling companies), air traffic control, and police. To that end a safety congress exists through which each of these entities can meet as needed in response to a major accident or incident. This group can collaboratively review the information collected about the incident or accident by each entity to identify potential causes and determine which actions each of the entities involved should take to prevent a similar event.

The airport has a safety management system in place, and as part of that process a periodic review of accident reports is conducted to identify problem areas as well as to review whether improvements have been realized from previous operational changes related to safety issues. The safety department conducts this review and provides recommendations independent of the operations groups, which have the responsibility to implement and monitor adherence to the regulations.

Reporting

Airport operations responds to reports of apron accidents and incidents and completes investigation reports in conjunction with airport police. The safety department is responsible for tracking incidents and accidents that take place in the apron area and for reviewing airport policies and procedures.

8.2 Toronto Pearson International Airport

Toronto's Pearson International Airport site visit was held on April 18, 2011, by one member of the research team. The site visit included a detailed review of the apron from the airport's apron control tower in Terminal 3. Additionally, the site visit included meeting with the airport's operations and customer experience department, apron operations, and the staff in the apron control tower. Some key facts about the airport and the apron area are:

- Owned by Transport Canada and operated by the Greater Toronto Airports Authority.
- Annual aircraft operations: 407,000.
- Two terminals, seven concourses.
- 108 active gates.
- All gates are common use.
- Aircraft parking linear frontage: 15,500 ft.
- 70 airline operators.

Apron Description

The terminal complex at Toronto Pearson International Airport includes two adjacent terminals, each with three pier concourses. Exhibit 8-2 provides an overview of the airport apron areas. Vehicle service roads in the apron area are located behind the aircraft parking positions. An 11-gate remote concourse located across Runway 15L-33R from the terminal area is currently not used on a regular basis.

Apron Control

Toronto Pearson International Airport has an apron control unit within its airside operations division. The apron control unit functions from a ramp control tower and provides aircraft movement control in the apron area and coordinates handing off aircraft control to NAV CANADA's ground control. The apron control unit is responsible for the allocation of a majority of the gates, which are all operated on a common-use basis. A separate group within airside operations is responsible for assigning terminal resources such as common-use ticket counters and baggage claim units.

Apron control works closely with the airlines and the ground handling providers to assess the impacts on gate usage of changes in scheduled arrival and departure times. It was reported that every effort is made to utilize gates in a manner that provides efficiency for ground handling (i.e., assigning international flights serviced by the same ground handling company to adjacent gates), but ultimately providing gate facilities to all aircraft with minimal or no delay is the first priority.

Safety Awareness and Training

The airport has instituted an SMS, and all tracking of apron-related incidents or accidents is done within the SMS process. The safety officer reviews reports for commonalities and makes recommendations for changes in procedures or other actions to improve the safety of the apron area.

An airside safety committee meets monthly to review safety issues related to the apron and the airfield. This committee consists of an airport safety officer, airport operations, airfield maintenance, the airlines, and ground handling providers. Topics include FOD reduction, periodic bulletins on safety awareness, and reviews of changes in procedures.

The airport also has two other notable safety-related initiatives. First, airport operations uses an email blast for notifications and bulletins. An example given was the notification to tenants that a high wind advisory had been issued for the upcoming week. The other program is an annual safety week, where airport representatives make safety-related presentations to apron area employees to reinforce safe operating practices.

In addition to the control and assignment roles in apron operations, the airport also establishes and enforces apron regulations. Airport operations can revise apron regulations through operations bulletins. These revisions are coordinated within operations and with airlines and ground handling providers.

The airport has designated ground equipment safety areas on the apron and monitors adherence with the use of those areas. To address a concern with multiple ground handling companies, the airport established GSE storage areas in the terminal area. Space within that area is reallocated each year based on the activity of each ground handling provider that maintains ground equipment at the airport. To address inoperable equipment, the airport has a tag-and-tow program but uses that only after notifying the airline or ground handling provider that a problem exists with a particular piece of equipment or vehicle.

Reporting

Apron accidents and incidents are reported to airport dispatch, which notifies the apron safety officer on duty and police, fire, or paramedics as required. Apron safety officers are trained in accident investigation and compile an incident report that is linked to the dispatch calls in a database. Other

Exhibit 8-2. Toronto Pearson International Airport apron layout.

Source: Google Earth

responders compile a report that is integrated into the same dispatch database. The reporting process is automated and uses vehicle-mounted laptops, and apron safety officers have the ability to attach photos to the reports.

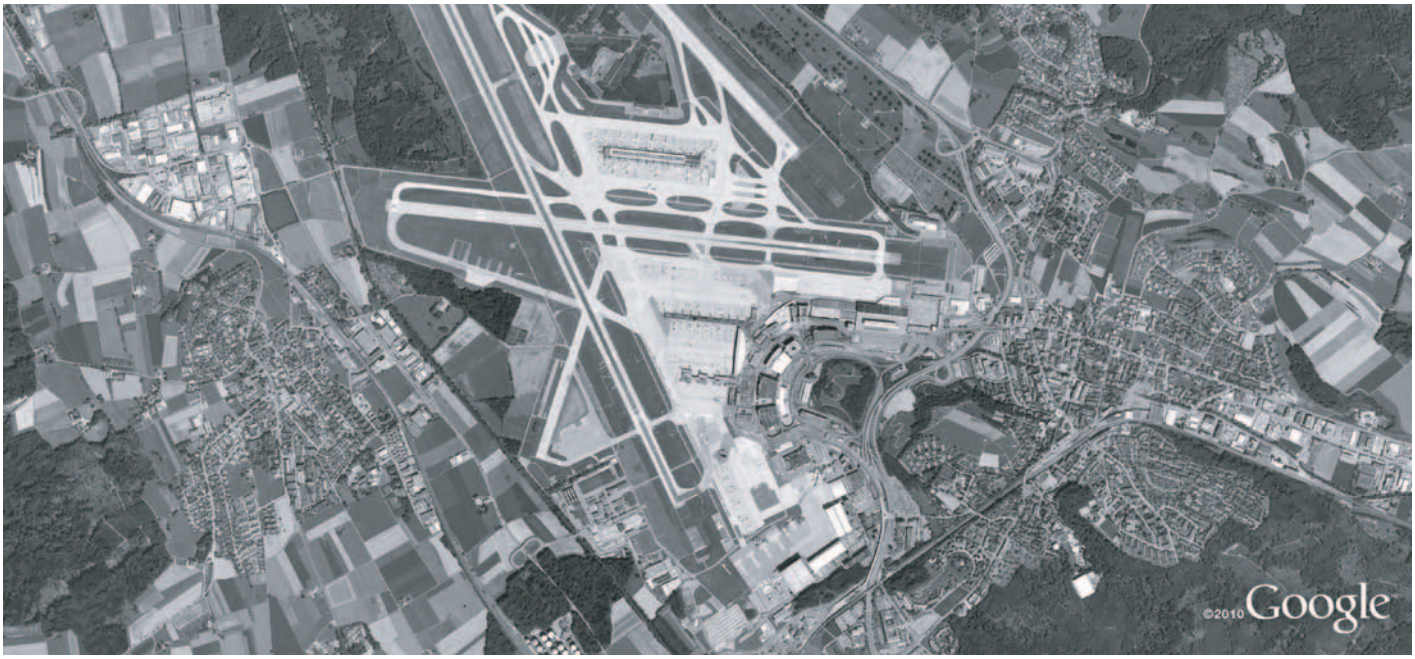
8.3 Zurich International Airport

The site visit at Zurich International Airport was conducted on April 13, 2011. Two members of the research team were present and met with the airport operations and flight operations departments, which provided a detailed review of apron operations. The visit included an airfield tour to evaluate physical and operations characteristics, and also included a tour of the apron control unit.

Some key facts about the airport and the apron:

- Owned and operated by Flughafen Zürich AG.
- Annual aircraft operations: 269,000.
- Two terminals, three concourses.
- 118 active gates.

Exhibit 8-3. Zurich International Airport apron layout.



Source: Google Earth

- All gates are common use.
- Aircraft parking linear frontage: 8,100 ft.
- 86 airline operators.

Apron Description

Exhibit 8-3 provides an overview of the airport apron areas. The apron at Zurich International Airport includes areas for remote aircraft parking and GSE staging. The majority of concourses are served with vehicle service roads behind the aircraft tails, while the new north terminal has a more efficient service road between the terminal and the nose of the aircraft. Markings on the ground in the gate area indicate the GSE staging areas. There are no wing-walkers at Zurich International Airport; all aircraft arrival and push-back operations are performed solely by the pilots, with assistance from markings on the ground and/or electronic docking systems.

Apron Control

Zurich International Airport has an apron control unit within its flight operations division, which is under the airport operations division. The apron control unit functions from the airport control tower and is located one floor below the tower control unit. The apron control unit provides guidance for and control of aircraft movements in the apron areas and on taxiways; it hands over aircraft to tower control when there is no more flexibility to change the aircraft sequence in taxi movements. The airport steering division uses an optimization system that evaluates the capacity of each component of the airport system and allocates gates accordingly (all gates are common use), assigns terminal resources such as common-use ticket counters and baggage claim units, and releases a departing aircraft from the gate at such a time that no wait will be required in a departure queue. Ultimately, the optimization system aims at providing the most efficient operation of the airport as a whole.

Safety Awareness and Training

The airport has instituted an SMS, and all tracking of apron-related incidents or accidents is done within the SMS process. The safety office reviews reports for commonalities and makes recommendations for changes in procedures or other actions to improve the safety of the apron area. The safety office is directly under the chief operating officer.

An airside safety committee meets quarterly to review safety issues related to the apron and the airfield environments. In keeping with the airport's collaborative decision-making culture, all airport stakeholders exchange data at no cost. Every division at Zurich International Airport is considered to be responsible for safety.

Reporting

Incident reporting is part of the SMS; however, reporting may be made anonymously. When an apron incident occurs,

it is reported to the apron control unit, which dispatches ramp safety to the incident site. The safety office then collects data, conducts an investigation if necessary, and produces a report. It also tracks data and makes recommendations when appropriate.

8.4 London Gatwick International Airport

The site visit at London Gatwick International Airport took place on April 14, 2011, with two members of the research team on site. The research team met with the airfield operations manager, who provided a detailed review of apron operations. The visit included an airfield tour to evaluate the physical and operational characteristics, as well as a tour of the airfield operations stand planning department. Some key facts about the airport and the apron area are:

- Owned by Global Infrastructure Partners and operated by Gatwick Airport Limited.
- Annual aircraft operations: 234,000.
- Two terminals.
- 122 pier stands and 68 remote stands.
- All but five gates are common use.
- Aircraft parking linear frontage: 10,900 ft.
- 62 airline operators.

Apron Description

Exhibit 8-4 provides an overview of the airport apron areas. Not all aircraft parking positions are equipped with an aircraft loading bridge; Gatwick is required to provide pier access to at least 95% of gates. A large number of remote aircraft parking positions are available. The majority of gates have multi-aircraft ramp system markings, which allow one large aircraft or two smaller aircraft to park in the apron space, based on needs. Hydrant fueling systems are installed at 95% of the gates. Gates at Gatwick International Airport are equipped with an aircraft guidance system that is switched on by a handling agent, who is responsible for ensuring that the gate area is clear before activating the system. The aircraft guidance system is employed to eliminate the need for ground crews to tug an aircraft into position.

Apron Control

There is no apron control unit at Gatwick International Airport. Departing aircraft contact clearance delivery to obtain their flight plan clearance, then subsequently contact ground control to obtain clearance to push back from the gate position and taxi. Pushback procedures are a function of runway use configuration. Upon reaching the runway, aircraft contact tower control. Arriving aircraft contact ground control once clear of the runway to obtain their taxi instructions to the stand. The airfield operations division at Gatwick

Exhibit 8-4. London Gatwick International Airport apron layout.

Source: Google Earth

International Airport uses an operation stand planning tool, which plans stand (i.e., gate) allocation 12 hours ahead of the event. On a priority basis, the system allocates a gate to long-haul flights first, then to point-to-point flights. All gates at Gatwick International Airport are common use, except for several gates at the north end of Terminal 5, for which British Airways has been assigned preferential use. The operations division meets daily with the ground handlers to optimize the aircraft parking plan.

Safety Awareness and Training

The airport has instituted an SMS, and all tracking of apron-related incidents or accidents is done within the SMS process. There is no safety division at Gatwick International Airport. An external safety consultant administers the SMS program. The airside operations division performs many safety-related tasks, although each division at Gatwick International Airport is considered to be responsible for safety.

At Gatwick International Airport, all internal processes are reevaluated annually, while airport-wide procedures (including safety procedures) are reevaluated every 3 years.

Every Wednesday, the airside operations division conducts random emissions testing of GSE. Also, Gatwick International Airport has an apron cleaning team to ensure that there are no FOD in the apron environment.

Gatwick holds a monthly health and safety meeting for all business units to share information and discuss ongoing incident investigations. The ramp safety group and the airside safety group also meet monthly.

All airport operations vehicles at Gatwick are equipped with a digital viewing mirror, which has a feature that allows recording of the last 60 seconds observed.

Reporting

All airside accidents and incidents have to be reported via phone to the airside operations division, which dispatches the appropriate services. Airside operations compiles an incident report that is submitted to an online database. Airport users and employees have the option of submitting an anonymous report via phone. The U.K. Civil Aviation Authority administers the Airfield Incidents Database. Landside incidents are reported to the Landside Operations Division.

SECTION 9

Comparison of Apron Management and Control

Through the series of site visits and interviews with airline, airport, and service provider personnel, an understanding of the apron operating environment, the control of activities within that environment, and the effectiveness of the apron control/management was formed. The site visits confirmed that U.S. airports do not typically provide the same level of active management and control of the apron environment as is provided at non-U.S. airports. Instead, U.S. airports rely primarily on the tenant airlines and ground service providers to safely and effectively manage the leased apron environment and to comply with operating procedures in the common-use (typically unleased) non-movement areas.

The research plan defined to guide the collection and analysis of data included a focus on the compilation of quantitative accident and incident data covering the apron area. This quantitative data was viewed as providing a means of comparing and evaluating the safety of the apron area in a regulated and an unregulated environment. Such information in a compiled and consolidated form is lacking in the industry, as documented in a report on aviation runway and ramp safety published in November 2007 by the GAO [*Aviation Runway and Ramp Safety: Sustained Efforts to Address Leadership, Technology, and Other Challenges Needed to Reduce Accidents and Incidents* (GAO-08-29)]. However, through the course of the research, including the site visits and interviews, it became apparent that gathering and compiling quantitative information detailing accidents/incidents would not produce the desired information due to consistent reluctance or refusal to provide the necessary and complete information.

While airports typically have some data on apron incidents or accidents to report, these data are not considered to be complete since not all events that occur are captured. Through the research effort, the response rate and the variability of information collected were deemed too low to draw usable conclusions or make appropriate comparisons. Contributing reasons for the limited and inconsistent apron event information submitted in response to the survey efforts included:

- Limited or incomplete information reported to airports by airlines and apron area service providers.
- Limited data routinely and consistently tracked (e.g., events causing less than a threshold amount of damage are not automatically tracked/recorded).
- Inconsistency in the primary and supporting information relating to specific events.
- Periods covered by the data were not consistent.

Additional background on the challenges associated with the collection of quantitative apron accident and incident data is presented in ACRP Project 11-02, Task 12, Preliminary Draft Final Report: Framework for a Database of Apron Incidents and Accidents, which is available at the project description website for that project at http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2691. Because of the limited ability to gather information that would allow a quantitative evaluation of the occurrence and extent of apron incidents and accidents, the resulting comparison and evaluation of the effectiveness of apron management and control programs with and without regulatory oversight is qualitative in nature. The project panel was made aware of the challenges encountered in attempting to gather quantitative information.

When accidents and/or incidents occur, despite the standards, procedures, and other measures in place to prevent them, learning from and preventing similar accidents and incidents are of key importance on both the airline and the airport side, irrespective of whether apron activities are controlled or regulated. Each entity has its own tailored internal approach to apron management and how it relates to safety. This section presents the major differences in the approaches to apron management between surveyed airports in and outside the United States.

As described in detail in Section 1, apron control programs are defined as regulations, policies, and systems designed to provide a safe and efficient environment in the ground area surrounding the terminal where aircraft, ground support, and servicing equipment and personnel operate simultaneously and in conjunction with each other. As expected, at the airports outside the United States, apron management and control is typically much more centralized through a specific apron control unit or department. These non-U.S. airports are typically responsible for more functions than airports in the United States, including gate allocation and assignment, ground handling, and integration with air traffic control. This is in part due to the lower prevalence of exclusive-use facility leases at non-U.S. airports. With facilities (i.e., gates) operated on a preferential or common-use basis, non-U.S. airports tend to play a more active role in the management and control of the apron areas.

In the United States, the respective airports and tenant airlines share responsibility for these functions. In the cases where an airline uses a contractor for specific servicing functions like ground handling, catering, or fueling, the operational coordination is directly between the airline and the contractor, without involvement by the airport. Airports typically do regulate the standards by which the contractor must operate in the apron area, but these are typically the same requirements and standards placed on an airline.

The research team found that outside the United States, apron management and control programs have evolved away from the need to allocate resources, specifically aircraft parking positions/gates (as well as ticketing and baggage claim areas that are outside the scope of this research), which are structured as common-use positions where the airport assigns aircraft to specific gates on a dynamic basis based on demand and specific aircraft type/size. This differs from the exclusive-/preferential-use model that is prevalent in the United States whereby the airlines lease specific gates and the apron areas associated with those gates and are responsible for managing the operations within that leased space. In the United States, the gate assignments for the most part are made by the leasing airlines, which, as noted, have access to a specific set of gates that are leased under exclusive-/preferential-use terms. In some cases, there are U.S. airports that control common-use gates or remote aircraft parking positions. In these cases, the operations department for the airports is generally responsible for allocating those resources, but it was not observed to be on a scale comparable to Toronto, Beijing, or Zurich. The common-use gates observed in the United States were not used on a regular basis but more typically on a contingency basis as in the event of a charter flight or unplanned maintenance issue requiring a parking position outside of an airline's exclusively or preferentially leased gates.

These differing lease structures represent the single biggest difference in how the responsibilities of apron management are approached within and outside the United States. Although the apron control units outside the United States are primarily responsible for gate allocation, they offer a single department from which all aspects of apron control can be managed. In the United States the operational and safety functions performed by those airports' apron control units are the same functions performed by a combination of parties: airport, airlines, and ground handling companies.

After the gate lease and use differences between airports within and outside the United States, the establishment of SMSs was identified as the other significant difference in how safety is addressed in conjunction with apron management. All of the airports outside the United States for which site visits were conducted have implemented an SMS. The research team ascertained from the site visits that apron safety is approached as part of the overall SMS program. In these cases the safety group within the airport organization reviews accident and incident data and recommends changes to operating procedures through the SMS process. Respondents outside the United States expressed the general belief that the SMS process was effective in identifying problem areas or potential issues and allowed for a collaborative approach to finding solutions to those problems, ranging from revising operational procedures to facility modifications/improvements. In several cases, it was learned that changes or improvements proposed through SMSs were coordinated with the airlines, paralleling the coordination that was reported between U.S. airports and airlines.

The following sections summarize the primary components of apron management and control at non-U.S. and U.S. airports.

9.1 Non-U.S. Airport Apron Management and Control

Management and control of the apron environment at non-U.S. airports, based on the site visits conducted through this research project, are typically airport-administered or airport-authority–administered responsibilities. Similarly, the airports that were the subject of the site visits all have an SMS in place, consistent with ICAO Annex 14 requirements, which requires the development of state safety programs and an SMS.

Because many non-U.S. airports operate and assign aircraft gates on a common-use basis, the apron control function typically maintains responsibility for the safe and efficient assignment of flights to gate positions. To maximize operational flexibility in the gate area, many non-U.S. gates are sized to accommodate a significant range of aircraft sizes. Additionally, gates at these non-U.S. airports tend to be dimensionally

larger in some cases than comparable gates at U.S. airports, allowing a less congested apron operating area in the vicinity of each gate and accommodating the staging of GSE in advance of aircraft arrival at any gate. The staging of GSE prior to the arrival of the aircraft tends to reduce the dynamic movement of vehicles and equipment in the area surrounding the aircraft. In general terms, these factors favor a safe operating environment.

The following points summarize those factors that contribute to the effectiveness of apron management and control at non-U.S. airports:

- Airport authorities/operating entities aggressively promote safety cultures throughout the airport environment on an active and ongoing basis. The safety culture is advanced through the implementation of an SMS and the establishment and enforcement of apron regulations covering operations and activities in the apron area. These regulations are reviewed and refined on a regular basis to reflect experiences and information collected through the SMS reporting of apron incidents and accidents.
- Safety in the apron environment is part of the overall airport SMS process and is treated similarly to safety in the movement area and the interior of the terminal in terms of risk assessment, safety promotion, and monitoring of results. This holistic treatment of safety as a culture is a key feature of SMSs.
- The establishment and enforcement of apron regulations support a consistent and routine operating environment, particularly in light of the common-use nature of gates at non-U.S. airports. Consistency tends to foster a safe operating environment since variability is reduced and both aircraft operators and ground service providers require less decision making in the active apron environment.
- Processes for documenting and reporting apron incident and accident information are defined and adhered to by airport management (through the SMS reporting process). Defined and consistent reporting tends to foster consistent use of terms and descriptions, consistent and repetitive investigative techniques and processes, familiarity with expected participation by involved parties, and other factors that aid in the normalizing of data collected. It also minimizes the potential for duplicative or inconsistent reporting that can obscure actual trends and conclusions.
- Active management of the use of the gates by the airports allows the apron control units to more closely monitor activities at each gate. Because an apron accident or incident would tend to affect the time that an aircraft occupies a gate by delaying departure, the apron control unit will often have an early indication of the potential occurrence of a reportable event, which enhances timely reporting and investigation.
- Training is a central component of apron management and control programs and SMSs. Training is both an initial and ongoing requirement, but it is also a remediation measure in many cases where an adverse apron incident is reported.
- Airlines and airports maintain the same objective of preserving and promoting a safe operating environment for employees, equipment operators, and travelers.

9.2 U.S. Airport Apron Management and Control

Apron management and control at U.S. airports tends to be, with few exceptions, an airline-administered responsibility in the leased areas of the apron. While there is a lack of centralized apron management and control that is evenly administered to all airport users, the apron environment is functionally managed and controlled on an individual, leased-area basis, coupled with airport regulations guiding activities in unleased apron areas. Less common but operationally equivalent, an FBO service provider may manage the apron area for a facility that does not have a predominant airline presence. The majority of U.S. airport apron areas are leased on either a preferential- or exclusive-use basis, with airlines controlling and managing the activities that occur and the operating procedures employed within these areas.

Using preferentially or exclusively leased gates/apron areas typically allows airlines significant freedom to accommodate a varying aircraft fleet as long as the parked aircraft do not create a safety issue or impinge on the leased area or operational flexibility of adjacent facilities/gates. The accommodation of a variable fleet within a leased area can mean that aircraft parking is maximized by minimizing wingtip clearances (subject to airline operating procedures), limiting GSE storage and staging areas, and defining segmented and complex gate entry and exit maneuvers. In these cases, the available space for GSE maneuvering in the vicinity of the parked aircraft can be significantly constrained, reducing the margin of error available to avoid incidents or accidents in the apron environment.

The following points summarize those factors that contribute to the effectiveness of apron management and control at U.S. airports:

- Airlines aggressively promote safety cultures throughout the organizations on an active and ongoing basis. The safety culture is advanced through the use of standard operating procedures developed to cover operations and activities in the apron area. Standard procedures are amended, expanded, supplemented, eliminated, and otherwise renewed on an ongoing basis as necessary to address documented deficiencies, changes in equipment, modified

training, revised airport regulations, and other relevant factors. Many of the airlines interviewed through this research revealed the existence of internal SMSs.

- Initial and recurrent training of employees is common within airlines and ground service providers in order to maintain awareness of safety in the operating environment. This training is in addition to any training required by an airport for operating vehicles and equipment in the apron or movement areas.
- Service providers that have contractual relationships for servicing aircraft (fueling, catering, lavatory servicing, etc.) are required to either comply with the respective airline operating and safety procedures or submit their own operating and safety procedures for review and approval by the contracting airline. This allows an airline to ensure that appropriate, consistent, and acceptable operating and safety procedures are employed for activities in the apron area even if those activities are conducted by personnel not employed by the airline.
- Airline attention to and prioritization of safety in the apron area is promulgated through the airlines' systems and stations. In this manner, airline experiences are shared throughout the organization so that all personnel benefit from experiences at any given station (airport). Typically, airlines use the results of investigations into incidents and accidents to determine whether system-wide changes to operating procedures are warranted, and if so, those are circulated throughout the airlines' networks simultaneously.
- Airline prioritization of a safety culture and safe operating environment reflects the adverse financial and operational impacts that result from injuries, equipment outages, and facility damage.
- Airlines typically require reporting of apron incidents and accidents by employees, typically irrespective of whether there are damages, injuries, or other significant consequences. Objectively, the reporting allows airlines to analyze collected data to identify trends, recurring issues, and other relevant factors that may be revealed only when aggregated information is available. In response to reported incidents or accidents, airlines typically follow a defined procedure for investigating the event, focused on understanding contributing factors and determining whether events are discrete and isolated or part of a larger pattern warranting a more systemic review and potential solution.
- Because airlines prioritize a safety culture and are motivated to appropriately address documented events, there is minimal perceived benefit to sharing compiled incident data outside of the organization. Similarly, there is a perceived disadvantage to sharing this data because of the potential for the information to be disseminated without context or background, including to entities without an interest in the productive investigation and resolution of these events.
- Although unregulated in a formal sense, the majority of the airports visited fostered a safety culture by providing routine meetings and other communication tools for identifying and resolving identified or potential safety issues. This culture fosters continuing communication, allows all participants to benefit from the experiences and improvements of others, and emphasizes the collective and organizational nature of maintaining a safe operating environment.
- Airlines and airports maintain the same objective of preserving and promoting a safe operating environment for employees, equipment operators, and travelers.

In comparing apron management and control systems in use at non-U.S. and U.S airports, it is difficult to assess on a quantitative basis whether a material difference is realized in terms of the rates, severity, and costs of apron incidents and accidents. However, in comparing the qualitative nature and aspects of apron control in regulated (non-U.S.) and unregulated (U.S.) environments, the conclusion can be reached that the operating environments are not significantly different in terms of prioritized safety. However, the source of the safety emphasis and prioritization differs in each case. In regulated environments, apron safety is prioritized by the regulating body (and adopted by airport users). Compliance with regulations is a motivating factor in this environment. In unregulated environments, apron safety is prioritized by the operators in an individualized manner. In these cases, overall safety in the apron environment is achieved through the aggregation of the safety emphasis and culture by individual operators supported by airport prioritization of safety and implementation of operating procedures and requirements for unleased non-movement areas that are not under the control of FAA ATC. Minimization of injury, damage, and operational disruption due to equipment being taken out of service are motivating factors in an unregulated apron environment.

Both in and outside the United States, the safety aspects of apron management are coordinated between airport, airlines, and ground handling providers. In the United States, as airports review and propose modifications to airport rules and regulations that apply to the apron environment, it is typically done in consultation with the tenant airlines. This helps to guide changes based on the airlines' collective experience on the apron and to aid in implementing such changes. Outside the United States, it was reported that when changes to procedures or apron regulations were necessitated as part of the SMS process, the airlines and ground handling companies were included in the process.

SECTION 10

Applicability of Apron Management Programs to U.S. Airports

Through the site visits and interviews, the research team identified one consistent observation: that safety is a high priority for entities that operate in and around the apron area, irrespective of whether they operate in a regulated environment or under an apron management program. It was repeatedly reported that the safety and well-being of employees and equipment are critical and that the financial and operational costs of injuries and equipment damage are too high for these to be anything but the highest priority.

10.1 Overview

The apron area was specifically cited by a number of interview participants as the primary area of safety concern, primarily because the largest number of airline and handling-company employees work in the apron environment and because of the area's dynamic nature with moving aircraft, vehicles, and equipment. As documented through the site visit and interview process, airports, airlines, and ground handling companies dedicate considerable resources on a continual basis to accident and incident prevention, ranging from training and awareness programs, recurrent training mandates, and defined communication protocols to development and maintenance of procedures for safe operating practices.

Airports and airlines recognize that the aviation industry relies heavily on both manpower and equipment to operate flights on a day-to-day basis. While there is a level of automation and technology that can influence the specific equipment and personnel in the apron environment where employed, the servicing and loading/unloading of aircraft cannot be accomplished without the presence of a variety of equipment and a minimum level of personnel in the vicinity of the aircraft. It is also recognized that a significant investment has been made in both equipment and the training and outfitting of personnel. The safe and efficient operation of the apron area is critical to airlines' ability to maintain schedule integrity, ensure that baggage and cargo make it to planned destinations in a timely manner, utilize equipment productively, and overall operate safely and efficiently in their leased and/or occupied facilities/areas.

With the occurrence of an accident or incident in the apron area, airlines can experience significant operational and financial consequences, including but not limited to:

- Delayed or canceled flights (immediate and downstream);
- Personnel injury, disability, or death;
- Insurance claims (equipment and personnel) or litigation;
- Aircraft damage (potentially being removed from service);
- Passenger perceptions; and
- Lost revenue/reassignment of passengers to alternate airlines.

These considerations highlight the overall and general incentive that airlines and airports have to prioritize safety in the apron area with or without regulations. Through the site visit process, particularly in meetings with tenant airlines, the emphasis on continual and vigilant monitoring, prioritization, and enhancement of safety was apparent.

Similarly, airports are motivated to prioritize safety in and around the apron environment and to enforce a safe operating environment. Incident response requirements and consequences, insurance claims/litigation potential, operational disruption, personnel injury/disability/death, equipment and facility damage, passenger and employee perceptions, and other potential consequences of a compromised safety environment motivate airports to promote and support the highest levels of safety in the apron environment, including leased areas not directly under the day-to-day control of airport management.

10.2 SMS Applicability

The relationship between SMSs and apron management and control programs is evolving in the United States, as demonstrated by the FAA's Notice of Proposed Rulemaking for SMSs at certificated airports (Docket No. FAA-2010-0997; Notice No. 10-14). Whereas FAR Part 139 regulations

currently only include the airport movement area (generally runways and taxiways), the NPRM includes implementation of an SMS in the non-movement areas, which would include the leased apron area surrounding the terminal. It should be noted that this regulation has not been finalized, and at the time of this research, industry comments are being received on the SMS NPRM. If implemented in the non-movement (apron) area, SMSs would shift the approach to apron safety at U.S. airports to a structure more in line with airports outside the United States, but significant coordination would be required given the differences in leasing practices, gate utilization, and other apron management responsibilities that are currently shared by airports and airlines in the United States.

10.3 Airport Certification Manual

Federally certificated airports are required under FAR Part 139 to prepare and maintain an airport certification manual (ACM), which documents an airport's compliance with applicable requirements of Part 139 reflecting the airport's size, type/level of activity, and configuration. Specific elements of the ACM that are relevant to apron management and control include airport personnel training, maintenance of training records, and ground vehicle access and activities in the movement areas. Frequently, an ACM will document the airport's incident and accident reporting responsibility (these can include vehicle–aircraft, vehicle–vehicle, and vehicle–equipment interactions), the duration of time that such records must be maintained, and the requirement that such records be available to the FAA if requested.

Additionally, Advisory Circular 150/5210-20, Ground Vehicle Operations on Airports, presents the FAA's guidance to airport operators on the establishment of procedures and policies concerning vehicle access and vehicle operation on the airside of the airport. These procedures and policies are recommended to address access, vehicle operator requirements, vehicle requirements, operations, and enforcement and are recommended to be incorporated into tenant leases and agreements. While ground vehicles represent only one component of the activities in the apron area, they are solidly represented in the apron accidents/incidents that occur.

These documents, along with other FAA guidance, reflect the emphasis on maintaining a safe operating environment at airports, which is an objective of apron management and control programs.

10.4 Applicability of Apron Management Programs

While an apron management and control requirement or regulated environment is deemed effective in non-U.S. airports, much of the perceived benefit (namely, the awareness and prioritization of safety in the apron environment) is already apparent at U.S. airports given the high-priority airline and airport focus on safety in the airside (whether leased or not), movement, and non-movement areas. The following considerations are relevant to the decision of whether the implementation of an apron management and control program enhances safety beyond levels currently achieved in an uncontrolled, airport- and airline-managed environment.

- Operating characteristics common at many U.S. airports require a level of flexibility and dynamic utilization of apron facilities to maintain an efficient operation. This is particularly critical at hub airports where airline schedules reflect distinct peaks over the course of the operating day. This flexibility facilitates efficient airline use in terms of aircraft parking configurations, fleet changes, GSE staging and storage, and other operational considerations in the apron environment. While apron management and control is not incompatible with a dynamic operating environment, the imposition of such a program must take into account the necessary flexibility of the U.S. airline/airport operating model.
- Unlike some non-U.S. airports at which the apron control unit is responsible for assigning gates, often significantly ahead of the flight arrival/departure, airlines typically manage leased gate/apron facilities at U.S. airports. In managing these facilities, airlines are typically able to achieve high gate utilization rates (daily departures per gate) as well as balance available facilities in the case of irregular operations. An apron management and control program, if required, must accommodate this level of gate utilization.
- The record-keeping, data compilation, and information management responsibilities associated with an apron management program may be significant if this information is intended for trend analysis and other manipulations in an effort to document changes in safety. While airlines currently bear this burden internally, a more centralized data repository would be necessary, with the burden anticipated to fall to the airport operator. However, an anticipated standardization in the data collected, investigative processes used in response to events, and other variables would tend to be enhanced with an airport-specific apron management program.
- Confidentiality of data would need to be maintained, particularly given the competitive aspects of U.S. airline operations. While there may also be legal concerns with the availability or release of data, the use of this information for competitive purposes should be limited.
- As noted, an apron management program at U.S. airports may include significant documentation requirements.

A clear use of this information is necessary if it is to be effectively collected. If no specific use is identified/planned, the inclusion of the centralized data collection requirement would not be warranted.

- Airport certification manuals, required for federally certificated airports, document policies and procedures that focus on safety in the operating environment. If apron management is desired due to perceived safety benefits, inclusion of the resulting requirements in the ACMs may provide a mechanism for formalizing the apron area operating and safety policies and procedures. However, for full effectiveness, these would necessarily have to apply to airlines, including the desired reporting requirements and sharing of accident and incident data.

Apron management and control programs, if regulated at U.S. airports, will generate additional documentation and record-keeping requirements; however, the perceived safety benefit of these programs is difficult to objectively measure or predict in the absence of quantitative data. Existing policies, practices, and procedures established within airports, airlines, and service providers address the safety of activities in the apron area; however, these do not ensure the comprehensive compilation of airport-wide data.

APPENDIX A

Online Screening Survey

1. Do you represent:
   - ☐ An airport
   - ☐ An airline
   - ☐ Other (please specify) _____

2. Who manages the apron area at your airport?
   - ☐ One airline that manages the entire apron area
   - ☐ Several airlines, where each airline manages the apron area associated with its respective gates
   - ☐ Airport
   - ☐ Third party (please specify) _____

3. What provides the airport's regulatory authority?
   - ☐ Airline lease agreement
   - ☐ City ordinance
   - ☐ Local rules and regulations specific to the airport
   - ☐ State statute
   - ☐ Other (please specify) _____

4. Do you have a set of procedures or regulations covering apron operations?
   - ☐ Yes (if possible, please provide an electronic copy)
   - ☐ No

5. Who develops apron operating procedures?
   - ☐ Airport
   - ☐ Airlines
   - ☐ Other (please specify) _____

6. Who is responsible for auditing compliance with apron operating procedures?
   - ☐ Airport police
   - ☐ Airport operations personnel
   - ☐ Other (please specify) _____

7. How frequently is apron compliance performed? _____

8. How is the apron area controlled?
   - ☐ Ramp tower
   - ☐ Other (please specify) _____

9. What apron areas are subject to control?
   - ☐ All apron areas
   - ☐ Portions of apron areas based on airline gate assignment

10. Apron control applies to:
    - ☐ Aircraft only
    - ☐ Aircraft and vehicles
    - ☐ Other (please specify) _____

11. Please list all types of operators allowed on the apron.
    - ☐ Airline personnel
    - ☐ Catering/flight kitchen
    - ☐ Aircraft cleaning
    - ☐ Aircraft fueling
    - ☐ Aircraft deicing
    - ☐ Concession deliveries
    - ☐ FBO
    - ☐ Contract maintenance
    - ☐ Baggage handling
    - ☐ Snow removal
    - ☐ Other (please specify) _____

12. What are the requirements for third-party operators (fueling, catering, etc.) to be allowed to operate in the apron area?
    - ☐ Training
    - ☐ Certification
    - ☐ Other (please specify) _____

13. Are personnel allowed on the apron subject to mandatory driver training?
    - ☐ Yes
    - ☐ No

14. Are the aprons at your airport equipped with hydrant fueling systems?
    - ☐ Yes, all gates are equipped
    - ☐ Yes, approximately _____ % of gates are equipped
    - ☐ No, no gates are equipped

15. Are towbarless tractors (supertugs) in use at your airport?
    - ☐ Yes
    - ☐ No

16. If yes to Question 15, do you have a specific operating procedure/policy in place for towbarless operations?
    - ☐ Yes—for apron areas only
    - ☐ Yes—for aircraft movement areas only
    - ☐ Yes—for apron areas and aircraft movement areas
    - ☐ No (If possible, please provide an electronic copy.)

17. Does your airport have an apron safety committee (or comparable entity)?
    - ☐ Yes (please describe the scope of this committee) _____
    - ☐ No

18. Please describe any apron safety initiatives or programs in place (i.e., local procedures, FOD prevention, safety awareness).

19. Does your airport have a formal safety management system in place?
    - ☐ Yes
    - ☐ No

20. If yes to Question 19, does the SMS include the apron area?
    - ☐ Yes
    - ☐ No

21. If yes to Question 19, please describe how the airport manages, audits, and regulates the tenants and third-party operators in that area.

    _____
    _____
    _____

22. At above what threshold do you report apron incidents/accidents?

    _____
    _____
    _____

23. How are apron incidents/accidents reported?

    _____

24. Is there a standard procedure for reporting apron incidents and accidents?
    - ☐ Yes
    - ☐ No

25. If yes to Question 24, what occurrences have to be reported as an apron **incident?**

    _____
    _____
    _____

26. If yes to Question 24, what occurrences have to be reported as an apron **accident?**

    _____
    _____
    _____

27. Does your airport have an apron management and control program?
    - ☐ Yes
    - ☐ No
    - ☐ If yes to Question 27, how is the apron management and control program administered?

    _____
    _____
    _____

28. If yes to Question 27, who does the apron management and control program apply to?

    _____
    _____
    _____

29. If yes to Question 27, what activities are covered by the apron management and control program?

☐ Concession deliveries	☐ Catering	☐ Aircraft cleaning
☐ Contract maintenance	☐ Aircraft fueling	☐ Baggage handling
☐ Aircraft deicing	☐ Snow removal	☐ _____

30. If yes to Question 27, what practices do you use in the administration of the apron management and control program?

31. If yes to Question 27, what factors affect the effectiveness of the apron management and control program? _____

32. If yes to Question 27, what are some limitations of the apron management and control program? _____

33. If yes to Question 27, how is compliance with the program monitored? _____

Survey Definitions:

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

Accident: An occurrence associated with the operation or handling of an aircraft in which a person is fatally or seriously injured or the aircraft sustains damage.

Serious injury: An injury that is sustained by a person in an accident and that:

- Requires hospitalization for more than 48 hours, commencing within 7 days from the date the injury was received;
- Results in a fracture of any bone (except simple fractures of fingers, toes, or nose);
- Involves lacerations that cause severe hemorrhage, nerve, muscle, or tendon damage;
- Involves injury to an internal organ;
- Involves second- or third-degree burns or any burns affecting more than 5% of the body surface; or
- Involves verified exposure to infectious substances or injurious radiation.

Apron management and control program: Regulations, policies, and systems designed to provide a safe and efficient environment in the ground area surrounding the terminal where aircraft, ground support, and servicing equipment and personnel operate simultaneously and in conjunction with each other.

APPENDIX B

Sample Questions to Guide On-Site Visit Discussions

Introduction

The purpose of ACRP Project 04-07 was to evaluate the effectiveness of apron management and control programs in and outside the United States. Many elements make up apron management and control programs, including regulatory actions such as inspection, training, and enforcement, as well as operational actions such as gate assignment and ground handling coordination.

The purpose of our visit is to discuss elements of apron management and control that your airport/airline/service provider has instituted and what impacts those programs have had on safety, as well as to gain an overall understanding of the apron environment and physical configuration and the operational characteristics (hubbing, international versus domestic, peaking characteristics). Specifically, the research team has an interest in the following areas:

Attributes of the Apron Area

1. Request a driving tour of the apron area and ramp tower(s), if applicable, to review the physical attributes of the apron area—single or multiple unit terminals/concourses, taxiway/taxi lane capabilities/dimensions, taxi flow patterns and chokepoints, aircraft pushback areas and procedures, ground vehicle staging, vehicle service road configurations, and so forth.
2. Identify areas that may influence safety of operations.
3. Determine if cargo apron is contiguous to or collocated with the passenger apron area. If connected, ask about cargo/passenger operational interface on the apron and ensure that cargo apron incident/accident data are included.

Apron Operations

1. Review of apron operation description and responsibilities (apron control unit, airport/airline ramp tower, no apron control)
   a. What are the airport's responsibilities with regard to apron operations?
   b. What are the airlines' and/or service providers' responsibilities with regard to apron operations?
   c. How are these integrated or coordinated?
2. Describe the history/evolution of the apron control unit or ramp tower, as applicable. When was this function established? Was the apron control unit or ramp tower established in response to an Annex 14 requirement, a particular goal or required functionality, or as part of terminal redevelopment? What organization operates the apron control unit and/or ramp control tower and what area does either of these have jurisdiction over? Are there apron areas not currently covered by any apron control unit or ramp tower?
3. Describe the history/evolution of the apron regulations (either enacted by the airport to airlines or service providers, or implemented by airlines or services providers as internal regulations). Distinguish between the minimum requirements under 14 CFR Part 139 and programs or initiatives over and above those requirements.

Safety Programs

1. Describe the scope of the safety-related programs that your airport/airline/service provider has implemented in the apron environment.

2. What shaped the development of those programs? (Local rates or trends of apron accidents, civil aviation authority mandates, safety agency mandates, SMS)
   a. Describe ongoing safety programs.
   b. When were these implemented?
   c. Were these implemented in response to a particular event or as part of the overall safety program or SMS?
   d. Try to distinguish which were implemented to meet a Part 139 requirement and which go above the minimum.
3. Was there a measurable change in accidents/incidents or apron events following implementation?
4. Describe the coordination between the airport, airlines, and service providers in the identification of safety issues and the development of policies, procedures, or regulations to address those safety issues.

Data Requests

1. Discuss the data collected to develop a complete understanding of how events are reported and tracked. Determine if airline and service provider data include events reported to the airport.
2. Identify other potential data sources.
3. Are there specific situations, physical constraints, procedures, and so forth that are believed to contribute to the occurrence or absence/prevention of apron events/conflicts (other than those already identified)?
4. Thoughts on benefits and implications of a national database of accidents and incidents:
   a. Level of effort by airports
   b. Frequency, record keeping, level of detail

Abbreviations and acronyms 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	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